

AD-A062 639

BOEING VERTOL CO PHILADELPHIA PA

F/G 1/3

INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFI--ETC(U)

SEP 78 P F SHERIDAN

DAAJ02-77-C-0020

UNCLASSIFIED

USARTL-TR-78-236-V-7A

NL

1 OF 3
ADA
062639

SEP



USARTL-TR-78-23G

LEVEL



B.S.

**INTERACTIONAL AERODYNAMICS OF THE SINGLE
ROTOR HELICOPTER CONFIGURATION**

**VOLUME VII-A - Frequency Analyses of Wake Split-Film Data,
Buildup to Baseline**

Philip F. Sheridan
Boeing Vertol Company
P.O. Box 16858
Philadelphia, Pa. 19142

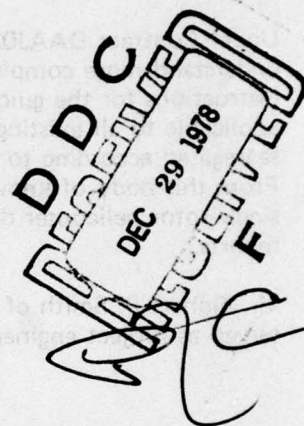
September 1978

Final Report for Period March 1977 - February 1978

Approved for public release;
distribution unlimited.

Prepared for

**APPLIED TECHNOLOGY LABORATORY
U. S. ARMY RESEARCH AND TECHNOLOGY LABORATORIES (AVRADCOM)
Fort Eustis, Va. 23604**



UUC FILE COPY AD A0 62 639

78 12 28 031

APPLIED TECHNOLOGY LABORATORY POSITION STATEMENT

In 1975 a wind tunnel test program was conducted in the Boeing-Vertol 20-foot V/STOL Wind Tunnel on a 1/5th-scale UTTAS model to investigate and find solutions for several aerodynamic problems encountered during the UTTAS flight-testing. Specifically, these tests focused upon (a) the structure of the hub/rotor wake in the vicinity of the empennage, (b) the formulation of the ground vortex and its relation to hub loads and fuselage loads during transition, and (c) the occurrence of vibratory air pressures from the blade passing over the fuselage. Only portions of the above-mentioned wind tunnel test data were reduced and analyzed in addressing the flight-test problems of the UTTAS aircraft.

Under Contract DAAJ02-77-C-0020, Boeing-Vertol completed analyses on the data to understand more completely the aerodynamic interactions that are involved and to formulate instructions for the guidance of designers in these respects. The results of these studies are applicable to all existing and future single-rotor/tail rotor helicopters. The data have been segregated according to aerodynamic interactions and associated phenomena/problem areas. From this body of knowledge, a generalized set of design guidelines meaningful to the single-rotor helicopter design concept formulation were developed and are included in these reports.

Mr. Robert P. Smith of the Aeronautical Technology Division, Aeromechanics Technical Area, served as project engineer for this effort.

DISCLAIMERS

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission, to manufacture, use, or sell any patented invention that may in any way be related thereto.

Trade names cited in this report do not constitute an official endorsement or approval of the use of such commercial hardware or software.

DISPOSITION INSTRUCTIONS

Destroy this report when no longer needed. Do not return it to the originator.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| 19 REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|--|-----------------------|---|
| 1. REPORT NUMBER 18 USARTI-TR-78-23G-V-7A | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle) INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION. Volume VII: Frequency Analyses of Wake Split- Film Data, Sub-volume Buildup to Baseline. | | 5. TYPE OF REPORT & PERIOD COVERED FINAL REPORT. 15 Mar 1977 - 13 Feb 1978 |
| 6. AUTHOR(s) 19 Philip F. Sheridan | | 7. PERFORMING ORG. REPORT NUMBER |
| 8. CONTRACT OR GRANT NUMBER(s) 15 DAAJ02-77-C-0020 | | 9. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62209A/1L262209AH76 00 189 EK |
| 10. PERFORMING ORGANIZATION NAME AND ADDRESS Boeing Vertol Company P.O. Box 16858 Philadelphia, Pa. 19142 | | 11. REPORT DATE 11 September 1978 17 88 |
| 12. CONTROLLING OFFICE NAME AND ADDRESS Applied Technology Laboratory, US Army Research and Technology Laboratories (AVRADCOM) Fort Eustis, Virginia 23604 | | 13. NUMBER OF PAGES 210 |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 12 212p | | 15. SECURITY CLASS. (of this report) Unclassified |
| 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. B= A061 861 | | |
| 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) | | |
| 18. SUPPLEMENTARY NOTES Volume VII of an eight-volume report Volume VII is comprised of seven sub-volumes (A thru G) | | |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Wake Interaction Empennage Flow Aerodynamic Interaction Flow Modifier Frequency Flow Environment Powered Model Spectrum Configuration | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is the first of seven sub-volumes of Volume VII containing spectrographs of the model helicopter hub/rotor wake as it was modified by various aerodynamic devices. This sub-volume deals with the wake changes as the model is built up to the baseline configuration. | | |

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

403 682

Jim

- D - Open Hubcaps
- E - Air Ejectors
- F - Air Ejectors With Hubcaps; Wings
- G - Fairings and Surface Devices

Volume VIII, Frequency Analyses of Wake Single Film Data

- A - Buildup to Baseline
- B - Basic Configuration Wake Exploration
- C - Hubcaps and Air Ejectors

TABLE OF CONTENTS

| | <u>PAGE</u> |
|---|-------------|
| INTRODUCTION | 6 |
| OUTLINE OF WAKE INVESTIGATIONS (TABLE 1). | 7 |
| LIST OF TEST RUNS (TABLE 2) | 11 |
| INDEX TO RAKE POSITIONS (TABLE 3) | 18 |
| RAKE ORIENTATION DIAGRAM (FIGURE 1) | 24 |
| HOT FILM RAKE LOCATIONS (FIGURE 2-6) | 25 |
| UTTAS 1/4.85 - SCALE MODEL GEOMETRY AND PRESSURE TRANSDUCER LOCATIONS (FIGURE 7) | 30 |
| SPLIT-FILM SPECTROGRAMS OF WAKE. | 31 |

| | |
|---------------------------------|---|
| ACCESSION for | |
| NTIS | Write Section <input checked="" type="checkbox"/> |
| DDC | Buff Section <input type="checkbox"/> |
| UNANNOUNCED | <input type="checkbox"/> |
| JUSTIFICATION | |
| BY | |
| DISTRIBUTION/AVAILABILITY NOTES | |
| Dist. | Serial |
| A | |

INTRODUCTION

Volume VII presents an array of machine plotted graphs of wake angle and velocity versus frequency in the band from 4 to 240 Hz derived from the split film transducers. This encompasses data in the spectrum through 10 times rotor speed which is 1433 RPM or 23.88 Hz.

The graphs showing wake frequency spectra are sequenced in the same order as the Outline of Wake Investigations (Table I). These graphs are distributed among Volumes VII-A through VII-G by the major categories of Table I in the following arrangement:

- Volume VII-A - Build-up to Baseline
- Volume VII-B - Basic Configuration
- Volume VII-C - Effect of Hub Caps Sections 1 & 2
- Volume VII-D - Effect of Hub Caps Sections 3 & 4
- Volume VII-E - Effect of Hub Caps Section 5 and
Effect of Air Ejectors
- Volume VII-F - Air Ejectors with Open Hub Caps and
Effect of Wings and Misc. Section 1
- Volume VII-G - Effect of Wings and Misc. Sections 2 & 3

The Table I outline and other material is included for reference and as context to the work of each sub-volume. Table 2, the List of Test Runs, arranges the runs in numerical order and gives pertinent text parameters.

The Index of Rake Positions, Table 3, lists the hot film transducer rake positions in the model coordinate system for each run and its test points. The main feature of Table 3 is the indexing of the test point number to the model water line station and butt line as it varied from run to run. The table groups the runs as they shared the indexing correspondence of point with position. It is emphasized that the runs in a group do not necessarily all share the same number of test points but they do have same correspondence within their respective ranges of test points.

The orientation of the rake is shown pictorially in Figures 1 through 6 for the various test runs. Figure 7 presents a scaled drawing of the model with reference to the three-axis coordinate system.

| TABLE 1 | | | |
|---|--------------------------------|---------|-----------|
| OUTLINE OF WAKE INVESTIGATIONS | | | |
| Description | Configuration Code | Run No. | Base-line |
| <u>Build-up to Baseline</u> | | | |
| 1. Nacelles removed | $K_{13}+H_1-N$ | 149 | 150 |
| 2. Blades off, rotating hub | $K_{13}-M+H_{1.0}$ | 160 | 156 |
| 3. " " , non-rotating hub | $K_{13}-M+H_{1.0}$ | 158 | 156 |
| 4. " " , hub off | $K_{13}-M-H_{1.0}$ | 159 | 156 |
| <u>Basic Configuration</u> | | | |
| <u>1. Wake Explorations near Empennage</u> | | | |
| (a) 15" Long. + traverse at T/R C.L. | K_{11} | 111 | --- |
| (b) 9" Vert. + " above T/R " | " | 112 | --- |
| (c) 2" " " in vortex | " | 113 | --- |
| (d) 8" " " (continue 112) | " | 114 | --- |
| (e) 13" " " behind stab. | " | 115 | --- |
| (f) Lateral traverse, left stab. (One T.P. only) | " | 116 | --- |
| (g) Same continued | " | 117 | --- |
| (h) Same continued (One T.P. only) | " | 118 | --- |
| (i) Lateral traverse right stab. | " | 119 | --- |
| (j) T/R effect on wake | $K_{11}+T_2^0$ | 121 | 115 |
| <u>2. Climb/Descent Studies</u> | | | |
| (a) Climb 900 FPM | K_{11} | 135 | --- |
| (b) Descent 800 FPM | " | 136 | --- |
| <u>Effect Of Hub Caps</u> | | | |
| <u>1. Solid Caps on Canister</u> | | | |
| (a) 7.6" diam. 2.17" ht. soft Pitch Arms | $K_{11}-H_{1.0}+H_{1.2}$ | 137 | 136 |
| (b) 7.6" diam. 2.17" ht. stiff Pitch Arms | $K_{13}+H_{1.2}$ | 153 | 156 |
| (b) 7.6" diam. 2.45" ht. flt. test config. | $K_{13}+H_{1.2.1}+I_1+E_{1.0}$ | 207 | 188 |

TABLE 1 (CONTINUED)

OUTLINE OF WAKE INVESTIGATIONS

| Description | Configuration Code* | Run No. | Base-line |
|---|---|---------|-----------|
| <u>Effect of Hub Caps (Continued)</u> | | | |
| 2. <u>Solid Caps Raised Above Canister</u> | | | |
| (a) 7.6" diam. 2.45" ht. 70" depth, .55 gap | H _{1.2.2} +I ₁ +E _{1.0} | 208 | 188 |
| (b) 10.0" diam. 3.25" ht. 1.55" depth, .50" gap | H _{1.8.1} +I ₁ +E _{1.0} | 189 | 188 |
| (c) 10.0" diam. 4.125" ht. 2.05" depth, .875" gap | H _{1.8.2} +I ₁ +E _{1.0} | 190 | 188 |
| (d) Repeat of 189 | " " " | 210 | 188 |
| 3. <u>Open Caps Without Underbody</u> | | | |
| (a) 10.0" diam. 1.25" gap, blades | H _{1.0.2} +I ₁ +E _{1.0} | 193 | 188/166 |
| (b) " " " gap, no blades | H _{1.0.1} -M | 166 | 158 |
| (c) " " 2.05" gap, blades | H _{1.14.1} +I ₁ +E _{1.0} | 211 | 188 |
| (d) " " 1.75" gap, no blades | H _{1.0.1} -M | 165 | 158 |
| (e) " " 1.87" gap, blades | H _{1.0.3} +I ₁ +E _{1.0} | 191 | 188 |
| (f) 16" diam. 2.00" gap, blades | H _{1.7.1} | 168 | 156/167 |
| (g) " " " gap, no blades | H _{1.7.1} -M | 167 | 158 |
| (h) " " 4.00" gap, blades | H _{1.7.2} | 169 | 156 |
| 4. <u>Open Caps with Underbody</u> | | | |
| (a) 7.6" diam. 1.25" gap | H _{1.11.1} +I ₂ +E _{1.0} | 194 | 188 |
| (b) " " " " | H _{1.11.1} +I ₂ +E _{4.0} | 198 | 188 |
| (c) " " " " center post | H _{1.11.2} +I ₂ | 202 | 194 |
| (d) 10.0" diam. .5" gap, no blades | H _{1.5.1} -M | 164 | 158 |
| (e) " " 1.25" gap, no blades | H _{1.5.2} -M | 161 | 158 |
| (f) " " 2.0" gap, no blades | H _{1.5.4} -M | 163 | 158 |
| (g) " " 4.0" gap, no blades | H _{1.5.3} -M | 162 | 158 |
| (h) " " 1.25" gap | H _{1.5.2} | 154 | 156/161 |
| *Basic Code is K13. | | | |

TABLE 1 (CONTINUED)

OUTLINE OF WAKE INVESTIGATIONS

| Description | Configuration Code* | Run No. | Base-line |
|---|---|---------|-----------|
| <u>5. Miscellaneous Hub Covers</u> | | | |
| (a) Hub fairing 16" diam. | H _{1.3} | 151 | 150 |
| (b) Wham-O-Frisbee 10" diam. | H _{1.9.0} +E _{1.2} | 182 | 181 |
| (c) Fab. glass Frisbee 16" diam. | H _{1.9.1} +E _{1.2} | 183 | 181 |
| <u>Effect of Air Ejectors</u> | | | |
| 1. Basic system no blowing | H _{1.0} +E _{1.0} | 172 | 156 |
| 2. " " 40 psi | " " | 173 | 156/172 |
| 3. " " 150 psi | " " | 174 | 156/172 |
| 4. Wide chord shroud 40 psi | H _{1.0} +E _{2.5.1} | 175 | 156/173 |
| 5. Wide " " 150 psi | " " | 176 | 156/174 |
| 6. W/C shroud w. lip 40 psi | H _{1.0} +E _{3.5.2} | 184 | 156/173 |
| 7. Same Contoured Parallel 150 psi | H _{1.0} +E _{3.5.4} | 187 | 156/174 |
| 8. Bifurcated duct 0 psi | H _{1.0} +E _{5.0} | 203 | 156 |
| 9. " " 40 psi | " " | 204 | 156/203 |
| 10. " " 150 psi | " " | 205 | 156/203 |
| <u>Air Ejectors with Open Hub Caps with Underbodies</u> | | | |
| 1. 7.6" diam. 1.25" gap, 0 psi | H _{1.11.1} +I ₂ +E _{1.0} | 194 | 188/172 |
| 2. " " " " 20 psi | " " " | 195 | 188 |
| 3. " " " " 40 psi | " " " | 196 | 188/173 |
| 4. " " " " 150 psi | " " " | 197 | 188/174 |
| 5. " " " " 0 psi | H _{1.11.1} +I ₂ +E _{4.0} | 198 | 188/194 |
| 6. " " " " 40 psi | " " " | 199 | 188/196 |
| 7. " " " " 150 psi | " " " | 200 | 188/196 |
| 8. Same with center post | H _{1.11.2} +I ₂ +E _{4.6} | 201 | 188/200 |
| 9. 10.0" diam. 2.0" gap wide ch'd. shroud (150 psi) | H _{1.5.4} +E _{2.5.1} | 177 | 156/176 |
| <u>Effect of Wings and Misc.</u> | | | |
| 1. Wings | | | |
| (a) Nacelle-mounted stub wing | H _{1.0} +W _{1.0} +E _{1.1} | 178 | 181 |
| (b) Single slotted flapped wing | H _{1.0} +W _{3.0} +E _{1.0} | 180 | 181 |
| (c) Double slotted flapped wing | H _{1.0} +W _{2.0} +E _{1.0} | 179 | 181 |
| (d) Boom-mounted stub wing | H _{1.0} +W _{4.0} | 186 | 156 |
| *Basic Code is K13. | | | |

| TABLE 1 (CONTINUED) | | | |
|--|------------------------------------|---------|-----------|
| OUTLINE OF WAKE INVESTIGATIONS | | | |
| Description | Configuration Code* | Run No. | Base-line |
| 2. Crown Fairings | | | |
| (a) Flat top behind shaft | K ₁₁ +D ₁ | 140 | 138 |
| (b) Round top behind shaft | K ₁₁ +D ₂ | 141 | 138 |
| (c) Extended flat top fairing | H ₁ +D ₄ | 170 | 156 |
| (d) Flat top + 16" cap, 4" gap | H _{1.7.2} +D ₄ | 171 | 170 |
| (e) Forward fairing/nacelle fairing | P _{1.0} | 152 | 156 |
| 3. Surface Devices | | | |
| (a) Vortex generators | K ₁₁ +VG _{2.1} | 139 | 138 |
| (b) Guidevane between nacelles | K ₁₁ +FV ₁ | 142 | 138 |
| (c) Longitudinal strakes | H _{1.5.3} +S ₄ | 155 | 156 |
| (d) 14% porosity spoiler | K ₁₁ +X ₁ | 143 | 138 |
| *Basic Code is K13 unless noted otherwise. | | | |

TABLE 2. LIST OF TEST RUNS
BASIC INVESTIGATIONS OF THE HUB WAKE

| RUN NO. | CONFIGURATION/CONDITION | VTUN KNOTS | RPM MR/TR | DISK LDG. psf | MODEL ANGLES | | MR HT. h/d | TAIL ROTOR |
|---------|--|------------|-----------|---------------|----------------|--------------|------------|------------|
| | | | | | α° | ψ° | | |
| 111 | K ₁₁ /15" Long. wake traverse at TR center line | 80 | 1433/0 | 8 | 6.0 | -2.0 | ∞ | Off |
| 112 | " /9" Vert. wake traverse above TR center line | " | " | " | " | " | " | " |
| 113 | " /2" Vert traverse through MR vortex | " | " | " | " | " | " | " |
| 114 | " /8" Vert. traverse below TR center line | " | " | " | " | " | " | " |
| 115 | " /13" Vert. traverse behind stabilizer | " | " | " | " | " | " | " |
| 116 | " /Lateral traverse - left stabilizer | " | " | " | " | " | " | " |
| 117 | " /116 continued | " | " | " | " | " | " | " |
| 118 | " /116 continued | " | " | " | " | " | " | " |
| 119 | " /Lateral traverse - right stabilizer | " | " | " | " | " | " | " |
| 121 | K ₁₁ +T ₂ /Effect of tail rotor flow on wake | " | 1433/4500 | " | " | " | " | On |
| 135 | K ₁₁ /Wake in 900 fpm climb | " | " | " | -6.0 | +4.5 | " | Off |
| 136 | " /Wake in 800 fpm descent | " | " | " | 6.0 | +2.0 | " | " |

TABLE 2(CONTINUED) LIST OF TEST RUNS
EVALUATION OF WAKE-ALTERING DEVICES

| RUN NO. | CONFIGURATION/CONDITION | VTUN KNOTS | RPM MR/TR | DISK LDG. psf | MODEL ANGLES | | MR HT. h/d | TAIL ROTOR |
|---------|---|------------|-----------|---------------|----------------|--------------|------------|------------|
| | | | | | α° | ψ° | | |
| 137 | K ₁₁ -H _{1.0} +H _{1.2} /Effect of 7.6 inch diam. solid hub cap | 80 | 1433/0 | 8 | 6 | -3.8 | ∞ | Off |
| 138 | K ₁₁ /Repeat of base run | " | " | " | " | " | " | " |
| 139 | K ₁₁ +VG _{2.1} /Effect of vortex generators on aft crown | " | " | " | " | " | " | " |
| 140 | K ₁₁ +D ₁ /Flat-topped "doghouse" fairing on aft crown | " | " | " | " | " | " | " |
| 141 | K ₁₁ +D ₂ /Rounded-top fairing | " | " | " | " | " | " | " |
| 142 | K ₁₁ +FV ₁ /Deflection vane on crown between nacelles | " | " | " | " | " | " | " |
| 143 | K ₁₁ +X ₁ /Variable porosity spoiler | " | " | " | " | " | " | " |
| 149 | K ₁₃ +H _{1-N} ₁ /Effect of nacelles off also add stiff pitch arms (K ₁₃) | 60 | 1075/0 | 4.5 | " | " | " | " |
| 150 | K ₁₃ +H ₁ /60 knot baseline | " | " | " | " | " | " | " |
| 151 | K ₁₃ +H _{1.3} /16 inch diam. helmet fairing | " | " | " | " | " | " | " |
| 152 | K ₁₃ +P _{1.0} /Pylon and intake fairings | 80 | 1433/0 | 8 | " | " | " | " |
| 153 | K ₁₃ +H _{1.2} /Repeat 137 with K ₁₃ pitch arms | " | " | " | " | " | " | " |

TABLE 2 (CONTINUED) LIST OF TEST RUNS
EVALUATION OF WAKE-ALTERING DEVICES

| RUN NO. | CONFIGURATION/CONDITION | VTUN KNOTS | RPM MR/TR | DISK LDG. psf | MODEL ANGLES | | MR HT. h/d | TAIL ROTOR |
|---------|---|------------|-----------|---------------|----------------|--------------|------------|------------|
| | | | | | α° | ψ° | | |
| 154 | K ₁₃ +H _{1.5.2/10} " open hub cap, 7" underbody, 1.25" gap | 80 | 1433/0 | 8 | 6 | -3.8 | ∞ | Off |
| 155 | K ₁₃ +H _{1.5.2+S₄} /Same as 154 except strakes on aft crown | " | " | " | " | " | " | " |
| 156 | K ₁₃ +H _{1.0} /Baseline with K ₁₃ , i.e., stiff pitch arms | " | " | " | " | " | " | " |
| 158 | K ₁₃ -M+H _{1.0} /Wake studies with blades off, hub not rotating | " | 0/0 | " | " | " | " | " |
| 159 | K ₁₃ -M-H _{1.0} /Wake studies with hub off | " | " | " | " | " | " | " |
| 160 | K ₁₃ -M+H _{1.0} /Same as 158 except hub is rotating | " | 1433/0 | " | " | " | " | " |
| 161 | K ₁₃ -M+H _{1.5.2} /Repeat of 154 without blades | " | 0/0 | " | " | " | " | " |
| 162 | K ₁₃ -M+H _{1.5.3} /Same as 161 except 4" gap | " | " | " | " | " | " | " |
| 163 | K ₁₃ -M+H _{1.5.4} /Same as 161 except 2" gap | " | " | " | " | " | " | " |
| 164 | K ₁₃ -M+H _{1.5.1} /Same as 161 except 0.5" gap | " | " | " | " | " | " | " |
| 165 | K ₁₃ -M+H _{1.0.1/10} " open hub cap, no underbody, same cap vert. position as Run 154 | " | " | " | " | " | " | " |
| 166 | K ₁₃ -M+H _{1.0.2} /Same as 165 with cap lowered by 0.5" | " | " | " | " | " | " | " |

TABLE 2 (CONTINUED) LIST OF TEST RUNS
EVALUATION OF WAKE-ALTERING DEVICES

| RUN NO. | CONFIGURATION/CONDITION | VTUN KNOTS | RPM MR/TR | DISK LDG. psf | MODEL ANGLES | | MR HT. h/d | TAIL ROTOR |
|---------|---|------------|-----------|---------------|----------------|--------------|------------|------------|
| | | | | | α° | ψ° | | |
| 167 | K ₁₃ -M+H _{1.7.1} /16" open cap, no underbody, 2" gap | 80 | 0/0 | 8 | 6 | -3.8 | ∞ | Off |
| 168 | K ₁₃ +H _{1.7.1} /Blades on, same cap config. as 167 | " | 1433/0 | " | " | " | " | " |
| 169 | K ₁₃ +H _{1.7.2} /16" open cap, no underbody, 4" gap | " | " | " | " | " | " | " |
| 170 | K ₁₃ +H _{1.0} +D _{4.0} /Extended flat top fairing on aft crown | " | " | " | " | " | " | " |
| 171 | K ₁₃ +H _{1.7.2} +D _{4.0} /Same fairing as 170 same cap as 169 | " | " | " | " | " | " | " |
| 172 | K ₁₃ +H _{1.0} +E _{1.0} (0psi)/Basic air ejector zero blowing baseline | " | " | " | " | " | " | " |
| 173 | K ₁₃ +H _{1.0} +E _{1.0} (40 psi)/Same as 172 with 40 psi supply | " | " | " | " | " | " | " |
| 174 | K ₁₃ +H _{1.0} +E _{1.0} (150 psi)/Same as 172 with 150 psi supply | " | " | " | " | " | " | " |
| 175 | K ₁₃ +H _{1.0} +E _{2.5.1} (40 psi)/Ejector with wide chord shroud at 40 psi | " | " | " | " | " | " | " |
| 176 | K ₁₃ +H _{1.0} +E _{2.5.1} (150 psi)/Same as 174 with 150 psi supply | " | " | " | " | " | " | " |
| 177 | K ₁₃ +H _{1.5} +E _{2.5.1} (150 psi)/Same as 176 with 10" cap like 163 | " | " | " | " | " | " | " |
| 178 | K ₁₃ +H _{1.0} +W _{1.0} +E _{1.1} (0 psi)/Nacelle mounted wing | " | " | " | " | " | " | " |

TABLE 2 (CONTINUED) LIST OF TEST RUNS
EVALUATION OF WAKE-ALTERING DEVICES

| RUN NO. | CONFIGURATION/CONDITION | VTUN KNOTS | RPM MR/TR | DISK LDG. psf | MODEL ANGLES | | MR HT. h/d | TAIL ROTOR |
|---------|--|------------|-----------|---------------|----------------|--------------|------------|------------|
| | | | | | α° | ψ° | | |
| 179 | K ₁₃ +H _{1.0} +W _{2.0} +E _{1.0} (0 psi)/Double slotted flapped wing | 80 | 1433/0 | 8 | 6 | -3.8 | ∞ | Off |
| 180 | K ₁₃ +H _{1.0} +W _{3.0} +E _{1.0} (0 psi)/Single slotted flapped wing | " | " | " | " | " | " | " |
| 181 | K ₁₃ +H _{1.0} +E _{1.2} (0 psi)/Baseline with ejector tube moved aft | " | " | " | " | " | " | " |
| 182 | K ₁₃ +H _{1.9.0} +E _{1.2} (0 psi)/Standard 10" frisbee | " | " | " | " | " | " | " |
| 183 | K ₁₃ +H _{1.9.1} +E _{1.2} (0 psi)/16" fabricated frisbee | " | " | " | " | " | " | " |
| 184 | K ₁₃ +H _{1.0} +E _{3.5.2} (40 psi)/Wide chord with lip at 40 psi | " | " | " | " | " | " | " |
| 185 | K ₁₃ +H _{1.0} +E _{3.5.2} (150 psi)/Same as 184 with 150 psi air | " | " | " | " | " | " | " |
| 186 | K ₁₃ +H _{1.0} +W _{4.0} /Boom mounted stub wing | " | " | " | " | " | " | " |
| 187 | K ₁₃ +H _{1.0} +E _{3.5.4} (150 psi)/Like 185 with modified shroud | " | " | " | " | " | " | " |
| 188 | K ₁₃ +H _{1.0} +I ₁ +E _{1.0} (0 psi)/Baseline with I ₁ instr. ring | " | " | " | " | " | " | " |
| 189 | K ₁₃ +H _{1.8.1} +I ₁ +E _{1.0} (0 psi)/Solid cap, 10" diam. 3.25" height | " | " | " | " | " | " | " |
| 190 | K ₁₃ +H _{1.8.2} +I ₁ +E _{1.0} (0 psi)/Same as 190 except + 4.12" height | " | " | " | " | " | " | " |

TABLE 2 (CONTINUED) LIST OF TEST RUNS
EVALUATION OF WAKE-ALTERING DEVICES

| RUN NO. | CONFIGURATION/CONDITION | VTUN KNOTS | RPM MR/TR | DISK LDG. psf | MODEL ANGLES | | MR HT. h/d | TAIL ROTOR |
|---------|---|------------|-----------|---------------|----------------|--------------|------------|------------|
| | | | | | α° | ψ° | | |
| 191 | K13+H1.0.2+I1+E1.0 (0 psi)/10" cap, no underbody, 1.87" gap | 80 | 1433/0 | 8 | 6 | -3.8 | ∞ | Off |
| 193 | K13+H1.0.2+I1+E1.0 (0 psi)/10" cap, no underbody, 1.25" gap | " | " | " | " | " | " | " |
| 194 | K13+H1.11.1+I2+E1.0 (0 psi)/7.6" cap, underbody, 1.25" gap | " | " | " | " | " | " | " |
| 195 | K13+H1.11.1+I2+E1.0 (20 psi)/Same as 194 with 20 psi air | " | " | " | " | " | " | " |
| 196 | K13+H1.11.1+I2+E1.0 (40 psi)/Same as 194 with 40 psi air | " | " | " | " | " | " | " |
| 197 | K13+H1.11.1+I2+E1.0 (150 psi)/Same as 194 with 150 psi air | " | " | " | " | " | " | " |
| 198 | K13+H1.11.1+I2+E4.0 (0 psi)/Same as 194 except blowing tube 2" aft | " | " | " | " | " | " | " |
| 199 | K13+H1.11.1+I2+E4.0 (40 psi)/Same as 198 with 40 psi air | " | " | " | " | " | " | " |
| 200 | K13+H1.11.1+I2+E4.0 (150 psi)/Same as 198 with 150 psi air | " | " | " | " | " | " | " |
| 201 | K13+H1.11.2+I2+E4.0 (150 psi)/Same as 200 except center support cap | " | " | " | " | " | " | " |
| 202 | K13+H1.11.2+I2/Baseline with I2 and no blowing tube | " | " | " | " | " | " | " |
| 203 | K13+H1.0+E5.0 (0 psi)/Bifurcated air duct baseline | " | " | " | " | " | " | " |

**TABLE 2 (CONTINUED) LIST OF TEST RUNS
EVALUATION OF WAKE-ALTERING DEVICES**

[illegible]

| TABLE 3 | | | | | |
|-------------------------|---------------|---------------|------------------|--------------|--------------------|
| INDEX TO RAKE POSITIONS | | | | | |
| RUN NUMBER | TEST POINT | WATER LINE | MODEL STATION | BUTT LINE | LOCATION FIGURE |
| 111 | 20 | 53.5 | 103.1 | -7.25 | 1 |
| | 21 | " | " | " | |
| | 22 | " | 105.0 | " | |
| | 24 | " | 107.0 | " | |
| | 26 | " | 109.0 | " | |
| | 28 | " | 111.0 | " | |
| | 30 | " | 112.9 | " | |
| | 32 | " | 114.9 | " | |
| | 34 | " | 116.9 | " | |
| | 36 | " | 118.9 | " | |
| 112 | 2 | 48.9 | 107.3 | -7.25 | 1 |
| | 4 | 50.8 | " | " | |
| | 6 | 52.7 | 103.3 | " | |
| | 8 | 54.5 | " | " | |
| | 10 | 56.2 | " | " | |
| | 12 | 57.2 | " | " | |
| 113 | 2 | 51.7 | 103.3 | -3.25 | 1 |
| | 4 | 52.3 | " | " | |
| | 6 | 52.8 | " | " | |
| | 8 | 53.3 | " | " | |
| | 10 | 53.9 | " | " | |
| | 11 | 53.3 | " | " | |
| 114 | 2 | 44.5 | 103.0 | -3.25 | 1 |
| | 4 | 46.4 | " | " | |
| | 6 | 48.2 | " | " | |
| | 8 | 50.0 | " | " | |
| | 10 | 51.9 | " | " | |
| 115 | 3 | 52.9 | 124.7 | -3.25 | 1 |
| | 4 | 52.0 | " | " | |
| | 6 | 50.0 | " | " | |
| | 9 | 48.0 | " | " | |
| | 10 | 46.0 | " | " | |
| | 12 | 44.1 | " | " | |
| | 14 | 42.1 | " | " | |
| | 16 | 53.0 | " | " | |
| | 18 | 54.0 | " | " | |
| | 20 | 55.0 | " | " | |

TABLE 3 (CONTINUED)
INDEX TO RAKE POSITIONS

| RUN NUMBER | TEST POINT | WATER LINE | MODEL STATION | BUTT LINE | LOCATION FIGURE |
|---------------|--|--|--|--|--------------------|
| 116 | 7 | 36.9 | 100.5 | -17.5 | 1 |
| 117 | 2 4 6 8 10 | 37.6 " 37.3 " " | 100.5 " 99.6 " " | -16.0 -14.0 -12.0 -10.0 - 8.0 | 1 |
| 118 | 2 | 37.6 | 100.5 | - 6.0 | 1 |
| 119 | 2 5 8 9 14 16 20 25 | 37.3 " " " " " 51.5 52.3 | 99.6 " " " " " 102.5 101.7 | + 6.0 8 10 " 14 16 17.5 -17.5 | 1 |
| 121 | 3 4 6 8 10 | 62.9 53.5 50.1 46.0 42.1 | 129.0 " " " " | + 5.7 " " " " | 2 |
| 135 | 2 4 6 8 10 12 14 | 56.9 54.5 52.5 50.5 48.5 46.5 44.5 | 106.3 " " " " " " | - 5.7 " " " " " " | 3 |
| 136 | 2 4 6 8 10 12 14 17 18 19 | 56.5 54.5 52.5 50.6 48.5 46.5 44.5 37.1 39.0 41.0 | 104.0 " " " " " " " " " | - 8.0 " " " " " " " " " | 4 |

TABLE 3 (CONTINUED)
INDEX TO RAKE POSITIONS

| RUN NUMBER | TEST POINT | WATER LINE | MODEL STATION | BUTT LINE | LOCATION FIGURE |
|-----------------------|-----------------------|-----------------------|--------------------------|----------------------|----------------------------|
| 137 | 3 | 38.7 | 98.4 | - 8.0 | 5 |
| | 5 | 39.9 | " | " | |
| | 7 | 42.0 | 100.5 | " | |
| | 9 | 44.0 | " | " | |
| | 11 | 46.0 | 103.6 | " | |
| | 13 | 48.0 | " | " | |
| | 15 | 50.0 | " | " | |
| | 17 | 52.0 | " | " | |
| | 19 | 54.0 | " | " | |
| 138-41, 143 | 2 | 38.8 | 98.4 | - 8.0 | 5 |
| | 3 | 40.0 | " | " | |
| | 4 | 42.0 | 100.5 | " | |
| | 5 | 44.0 | " | " | |
| | 6 | 46.0 | 103.6 | " | |
| | 7 | 48.0 | " | " | |
| | 8 | 50.0 | " | " | |
| | 9 | 52.0 | " | " | |
| | 10 | 54.0 | " | " | |
| 142 | 7 | 37.8 | 98.4 | - 8.0 | 5 |
| | 8 | " | " | " | |
| | 9 | 40.2 | " | " | |
| | 10 | 42.0 | 100.5 | " | |
| | 11 | 44.0 | " | " | |
| | 12 | 46.0 | 103.6 | " | |
| | 13 | 48.0 | " | " | |
| | 14 | 50.0 | " | " | |
| | 15 | 52.0 | " | " | |
| | 16 | 54.0 | " | " | |
| | 17 | 56.8 | " | " | |
| | | | | | |

TABLE 3 (CONTINUED)
INDEX TO RAKE POSITIONS

| RUN NUMBER | TEST POINT | WATER LINE | MODEL STATION | BUTT LINE | LOCATION FIGURE |
|---------------|---------------|---------------|------------------|--------------|--------------------|
| 149-151 | 2 | 38.8 | 98.5 | - 8.0 | 5 |
| | 3 | 40.0 | " | " | |
| | 4 | 42.0 | 100.6 | " | |
| | 5 | 44.0 | " | " | |
| | 6 | 46.0 | 103.5 | " | |
| | 7 | 48.0 | " | " | |
| | 8 | 50.0 | " | " | |
| | 9 | 52.0 | " | " | |
| | 10 | 54.0 | " | " | |
| | | | | | |
| 152-6, 158 | 2 | 42.9 | 97.9 | 0.0 | 6 |
| 161-4, 166 | 3 | 44.9 | " | " | |
| 167, 169-71 | 4 | 46.9 | 100.6 | " | |
| 175, 177-9 | 5 | 48.9 | " | " | |
| 180, 182, 184 | 6 | 50.9 | 104.6 | " | |
| 186-8, 190 | 7 | 52.9 | " | " | |
| 191, 193, 194 | 8 | 54.9 | " | " | |
| 196, 198, 201 | 9 | 56.9 | " | " | |
| 204, 207, 208 | | | | | |
| 211 | | | | | |
| 159 | 1 | 54.9 | 104.6 | 0.0 | 6 |
| | 2 | 52.9 | " | " | |
| | 3 | 50.7 | " | " | |
| | 4 | 48.6 | 100.6 | " | |
| | 5 | 46.7 | " | " | |
| 160, 203 | 5 | 42.9 | 97.9 | 0.0 | 6 |
| | 6 | 44.9 | " | " | |
| | 7 | 46.9 | 100.6 | " | |
| | 8 | 48.9 | " | " | |
| | 9 | 50.9 | 104.6 | " | |
| | 10 | 52.9 | " | " | |
| | 11 | 54.9 | " | " | |
| 165 | 3 | 44.9 | 97.9 | 0.0 | 6 |
| | 4 | 42.9 | " | " | |
| | 5 | 46.9 | 100.6 | " | |
| | 6 | 48.9 | " | " | |
| | 7 | 50.9 | 104.6 | " | |
| | 8 | 52.9 | " | " | |

TABLE 3 (CONTINUED)
INDEX TO RAKE POSITIONS

| RUN NUMBER | TEST POINT | WATER LINE | MODEL STATION | BUTT LINE | LOCATION FIGURE |
|--|---------------|---------------|------------------|--------------|--------------------|
| 168, 183 | 4 | 42.9 | 97.9 | 0.0 | 6 |
| | 5 | 44.9 | " | " | |
| | 6 | 46.9 | 100.6 | " | |
| | 7 | 48.9 | " | " | |
| | 8 | 50.9 | 104.6 | " | |
| | 9 | 52.9 | " | " | |
| | 10 | 54.9 | " | " | |
| 172 | 3 | 42.9 | 97.9 | 0.0 | 6 |
| | 4 | 44.9 | " | " | |
| | 6 | 44.9 | " | " | |
| | 7 | 46.9 | 100.6 | " | |
| | 8 | 48.9 | " | " | |
| | 9 | 50.9 | 104.6 | " | |
| | 10 | 52.9 | " | " | |
| 173, 174, 176 185, 195, 197 199, 200, 205 210 | 1 | 42.9 | 97.9 | 0.0 | 6 |
| | 2 | 44.9 | " | " | |
| | 3 | 46.9 | 100.6 | " | |
| | 4 | 48.9 | " | " | |
| | 5 | 50.9 | 104.6 | " | |
| | 6 | 52.9 | " | " | |
| | 7 | 54.9 | " | " | |
| 181 | 2 | 42.9 | 97.9 | 0.0 | 6 |
| | 3 | 44.9 | " | " | |
| | 4 | 46.9 | 100.6 | " | |
| | 5 | 48.9 | " | " | |
| | 6 | 50.9 | 104.6 | " | |
| | 7 | 52.9 | " | " | |
| | 9 | 54.9 | " | " | |
| | 10 | " | " | " | |
| | 11 | " | " | " | |
| | 12 | " | " | " | |
| | 13 | 42.9 | 97.9 | " | |
| | | | | | |
| | | | | | |

[illegible]

RUN 121

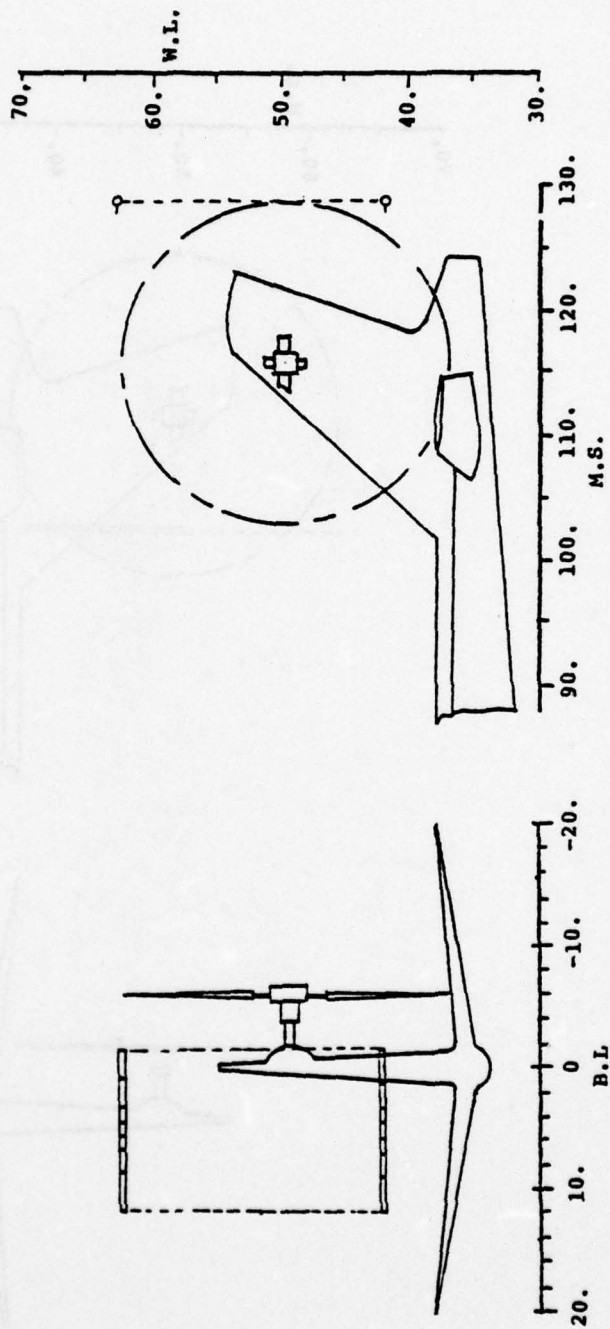


FIGURE 2 -HOT FILM RAKE LOCATIONS

RUN 135

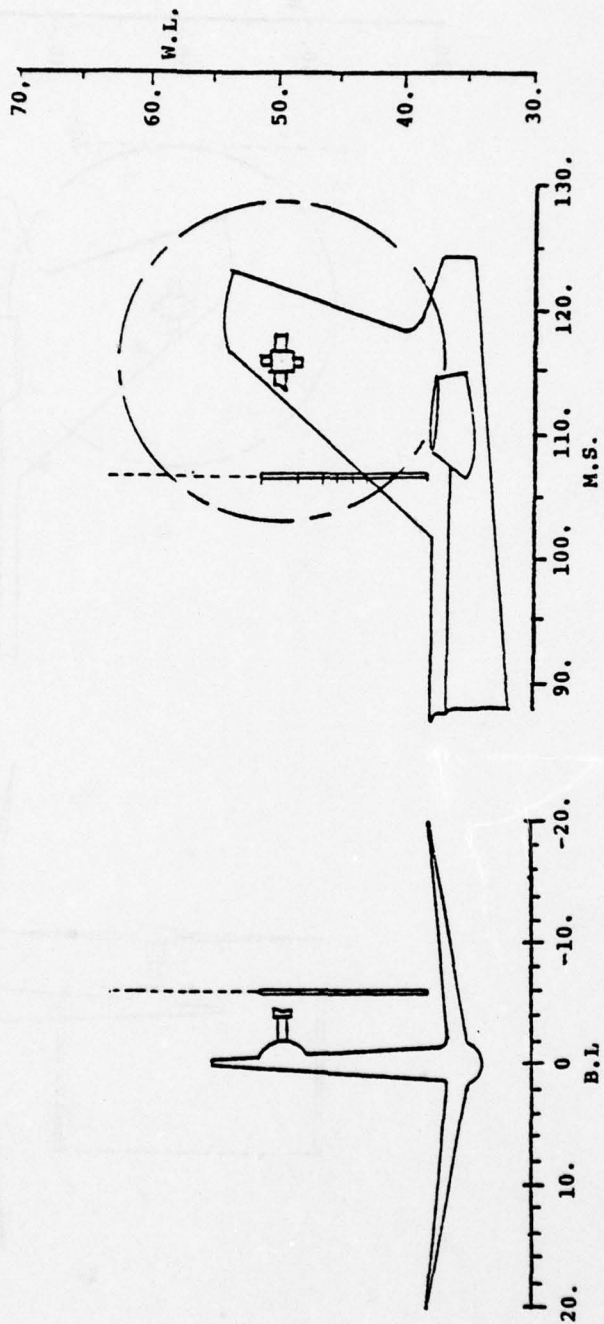


FIGURE 3 -HOT FILM RAKE LOCATIONS

RUN 136

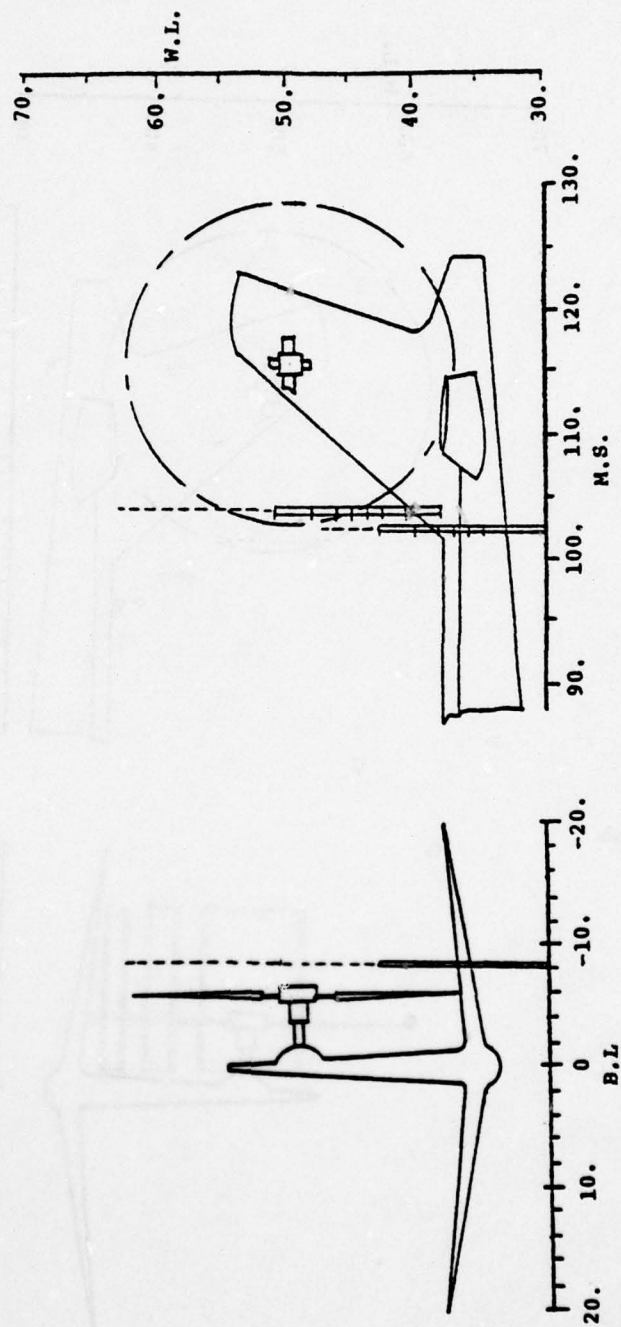


FIGURE 4 -HOT FILM RAKE LOCATIONS

RUN 137, 138, 139, 140, 141, 142,
143, 148, 149, 150, 151

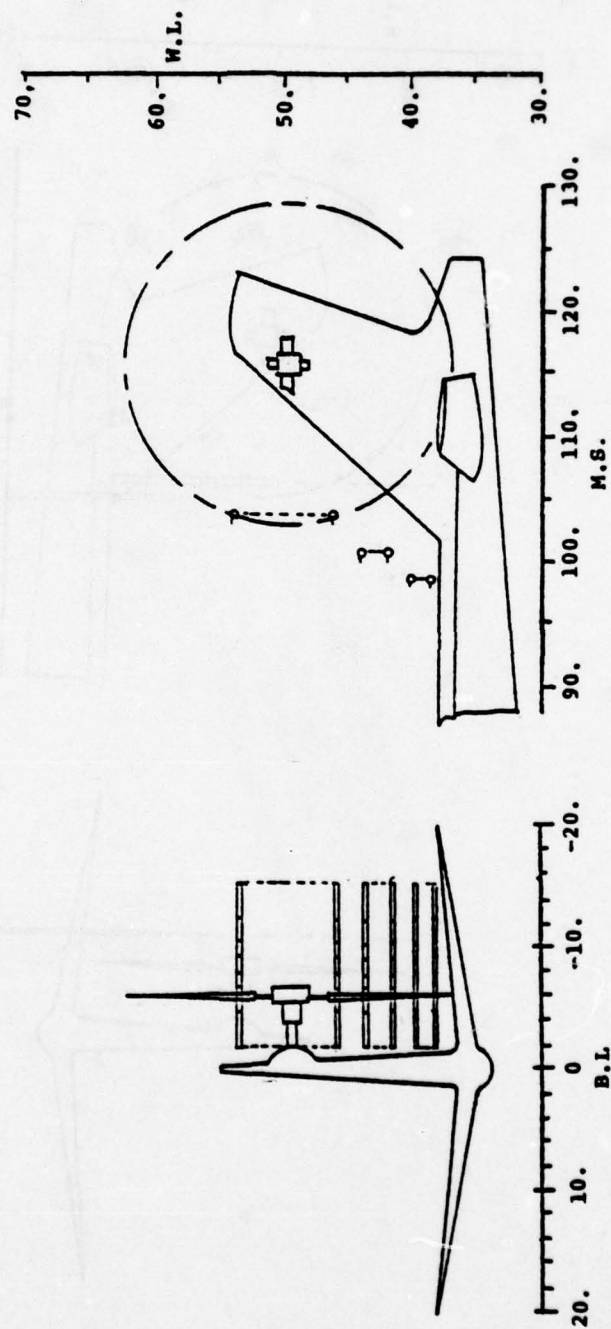


FIGURE 5 -HOT FILM RAKE LOCATIONS

RUN 152-156, 158-211

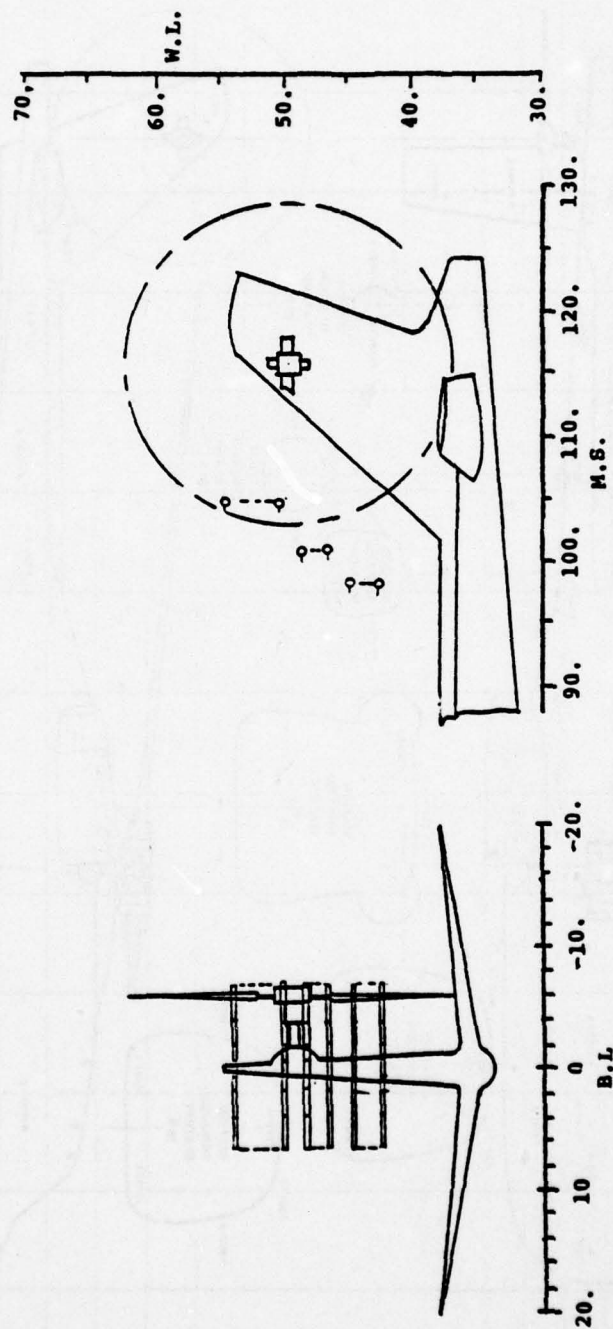


FIGURE 6 -HOT FILM RAKE LOCATIONS

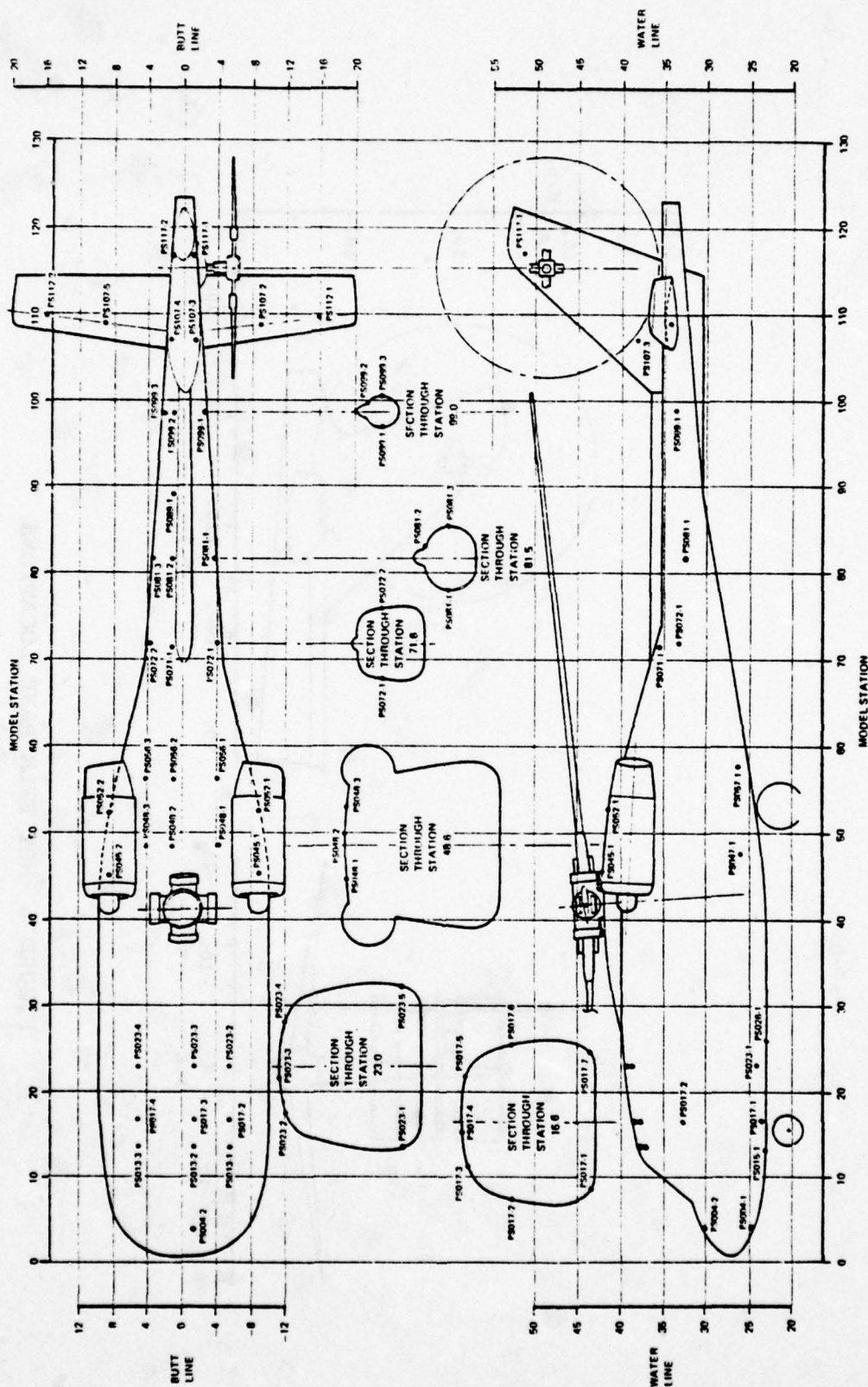
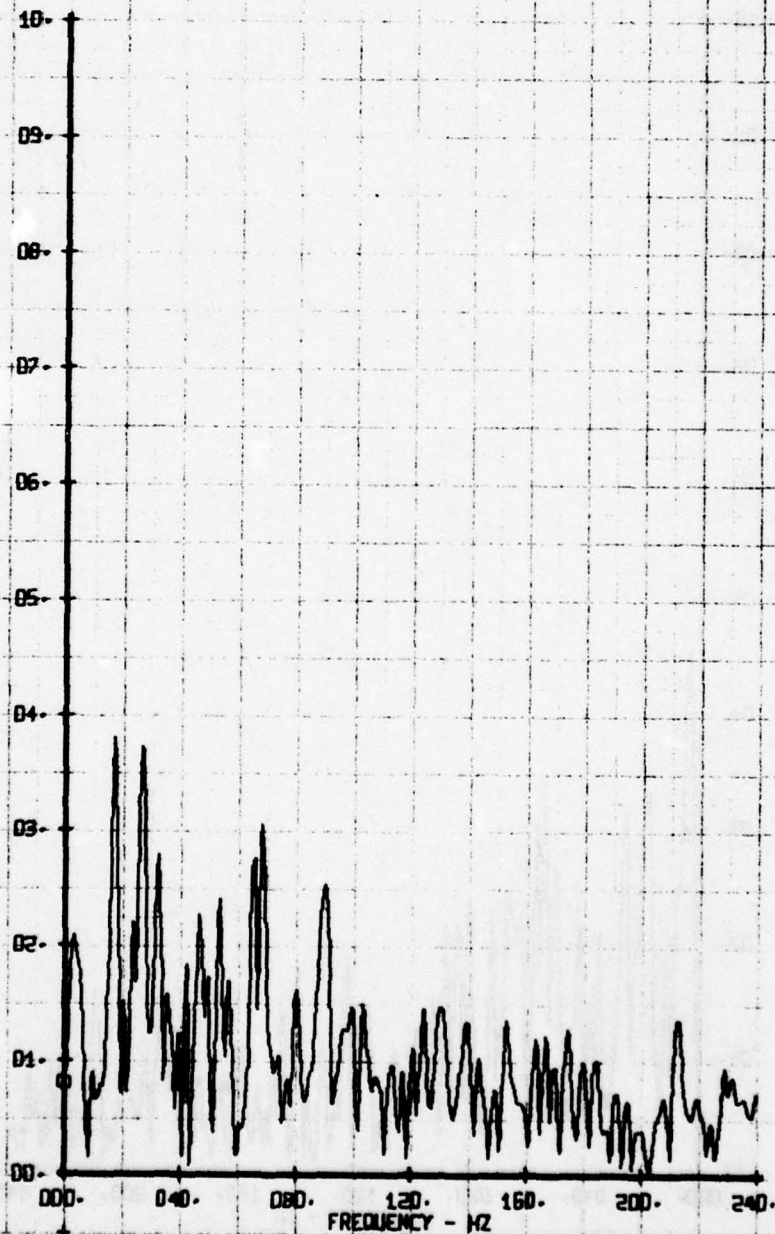


FIGURE 7 -1/4.85 SCALE MODEL GEOMETRY AND SURFACE PRESSURE TRANSDUCER LOCATIONS

HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NOZZLES OFF
RUN 149 TP 2

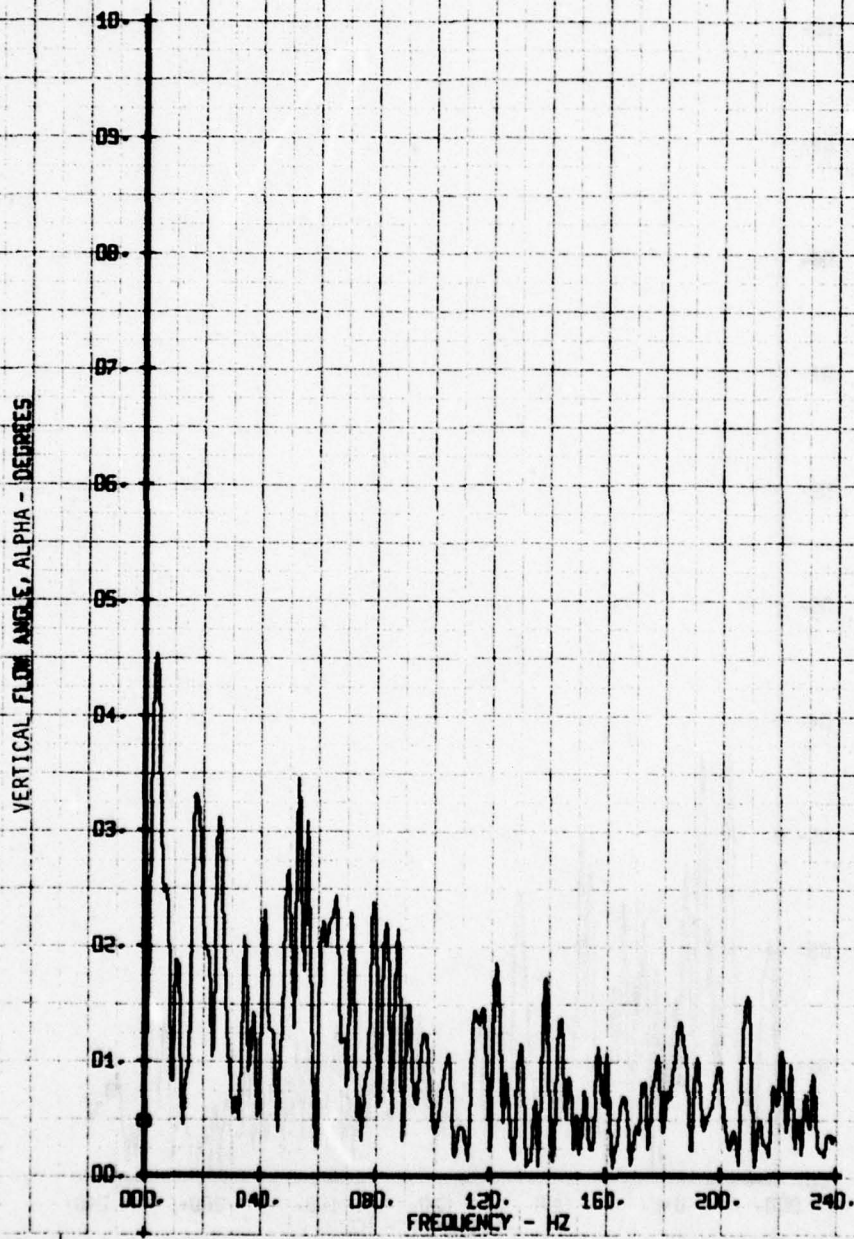
LEGEND
CH 66 PARAMETER
66 ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



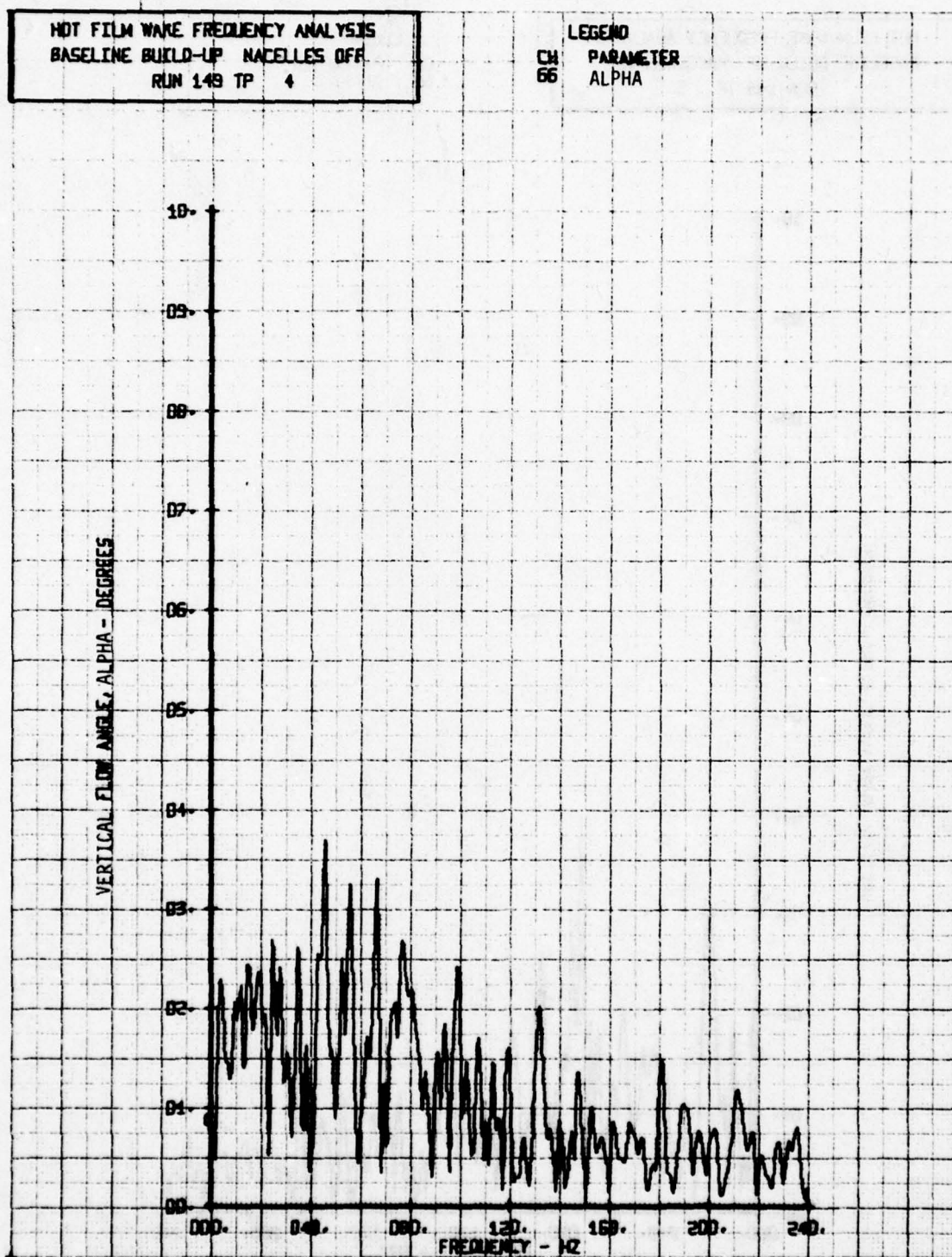
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NOZZLES OFF
RUN 148 TP 3

LEGEND
CH 66
PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 148 TP 4

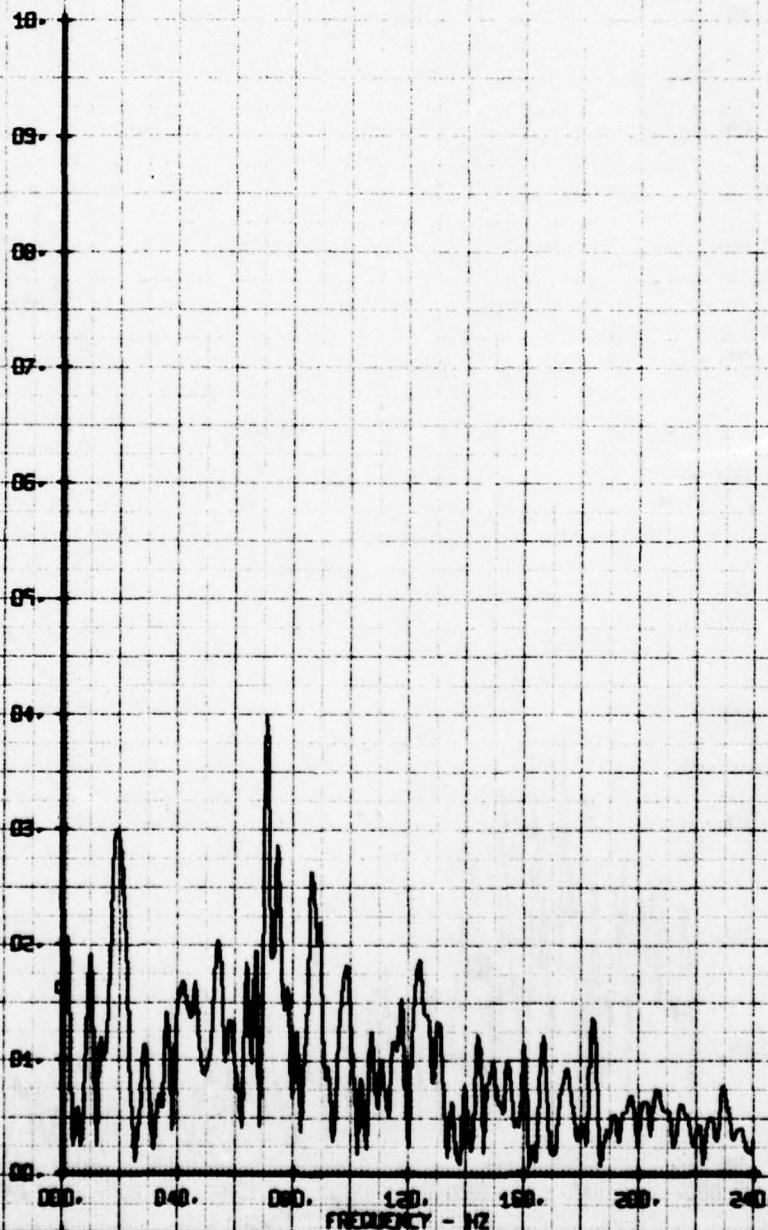
LEGEND
CH 66
PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 5

LEGEND
CH 66
PARAMETER
ALPHA

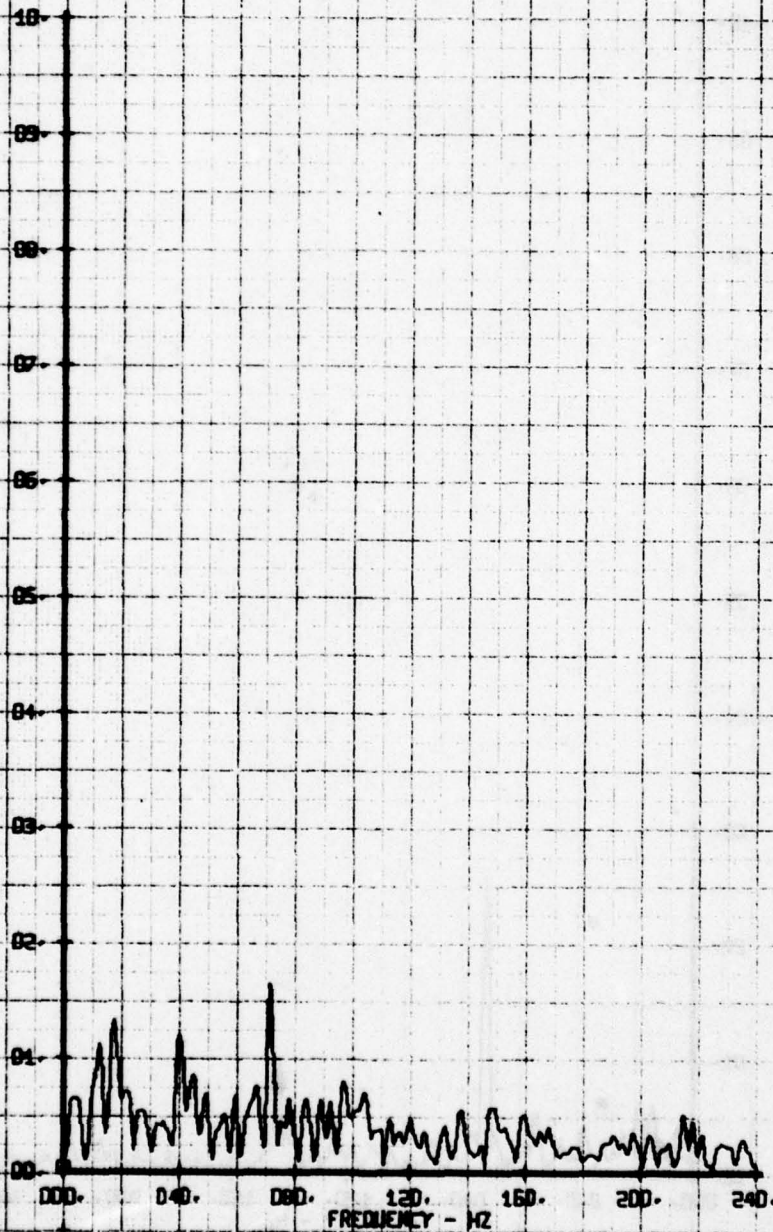
VERTICAL FLOW ANGLE, ALPHA - DEGREES



NOI FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 6

LEGEND
CH 56
PARAMETER
ALPHA

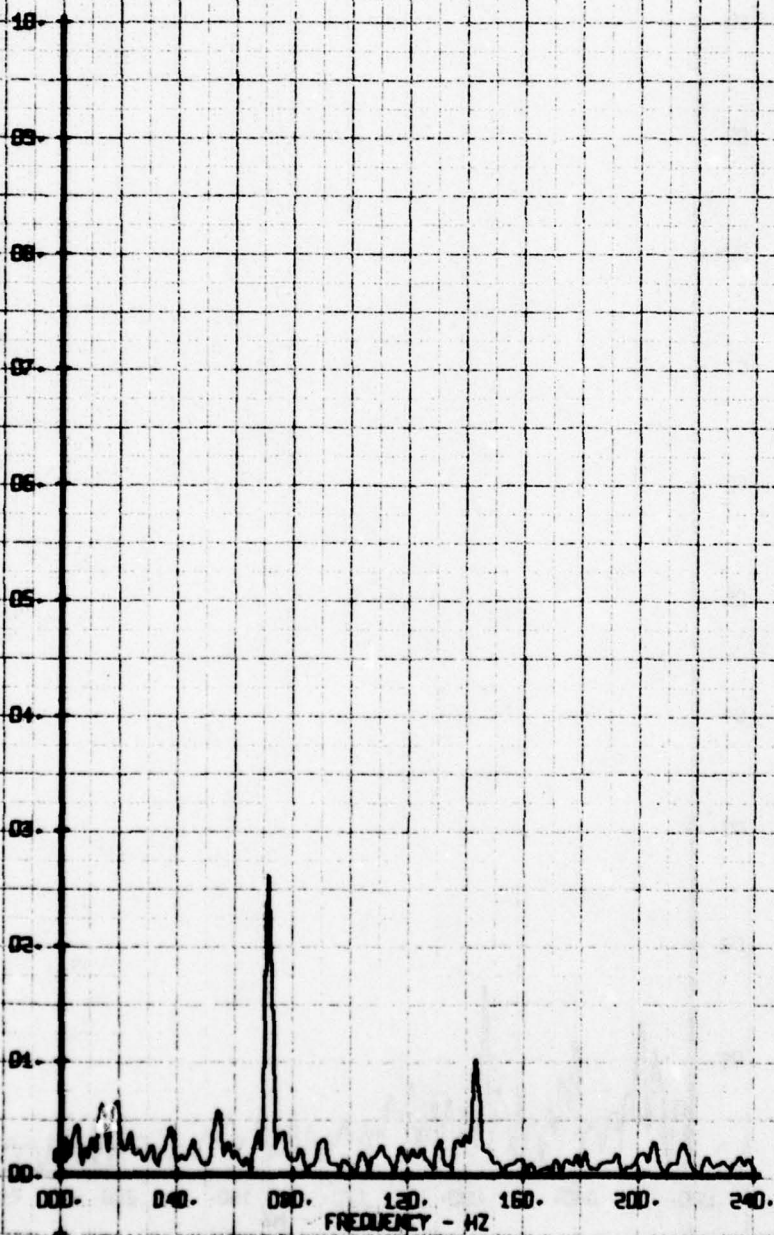
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE RUN 0-1P MACELLIS DEF
RUN 149 TP 7

LEGEND
CH PARAMETER
66 ALPHA

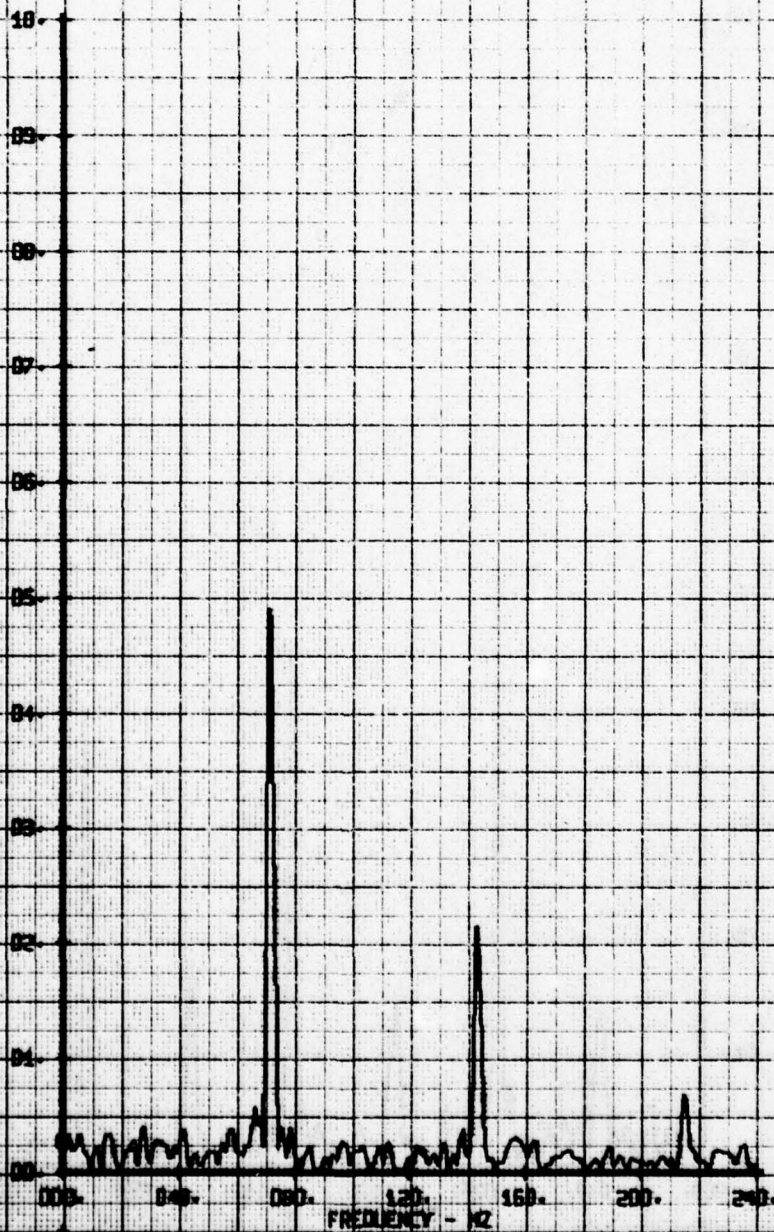
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 143 TP 8

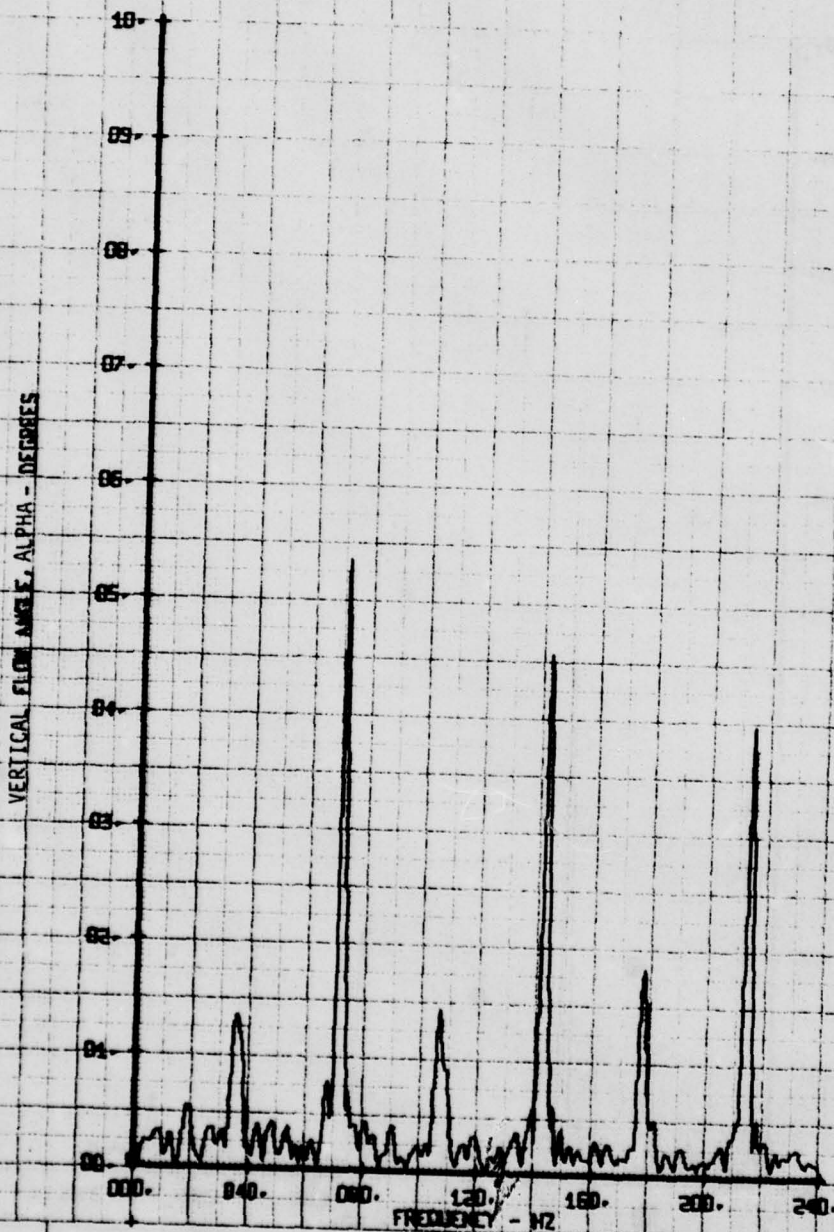
LEGEND
CH 66
PARAMETER
ALPHA

VERTICAL FLUX ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 9

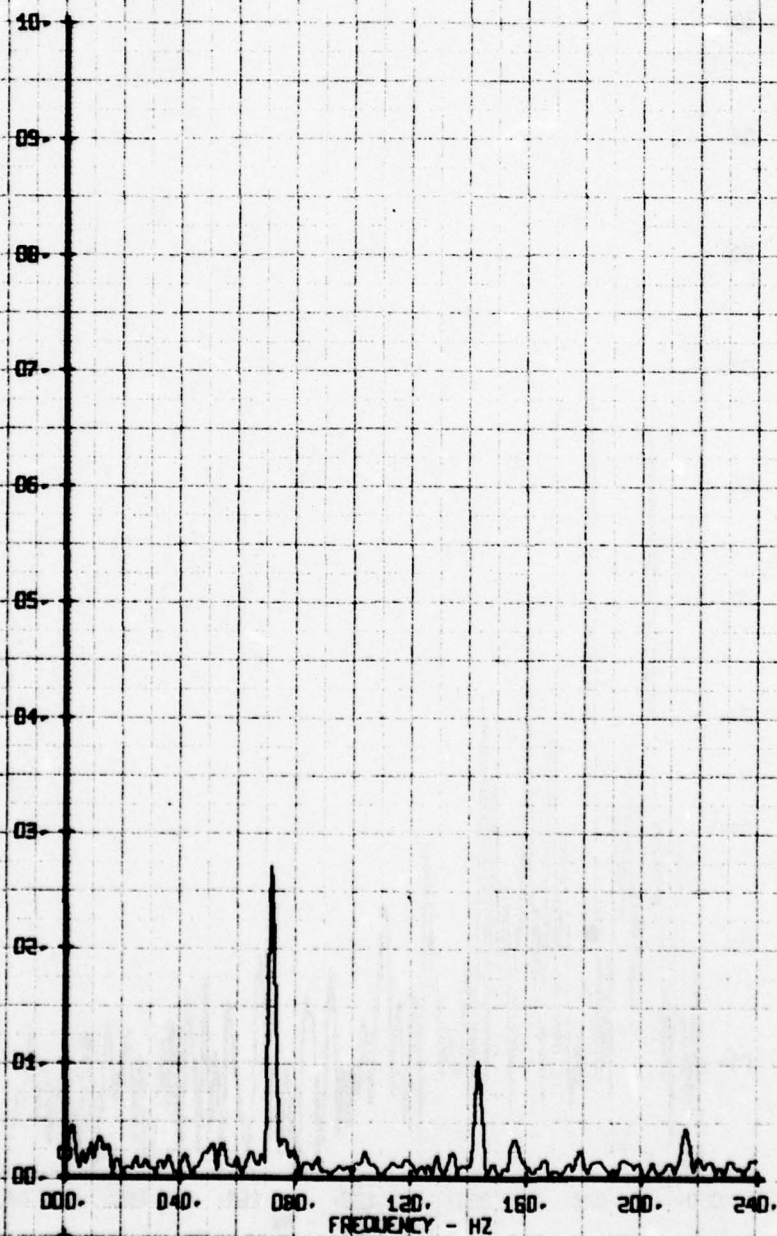
LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLRS DEF
RUN 149 TP 10

LEGEND
CH 66 PARAMETER
ALPHA

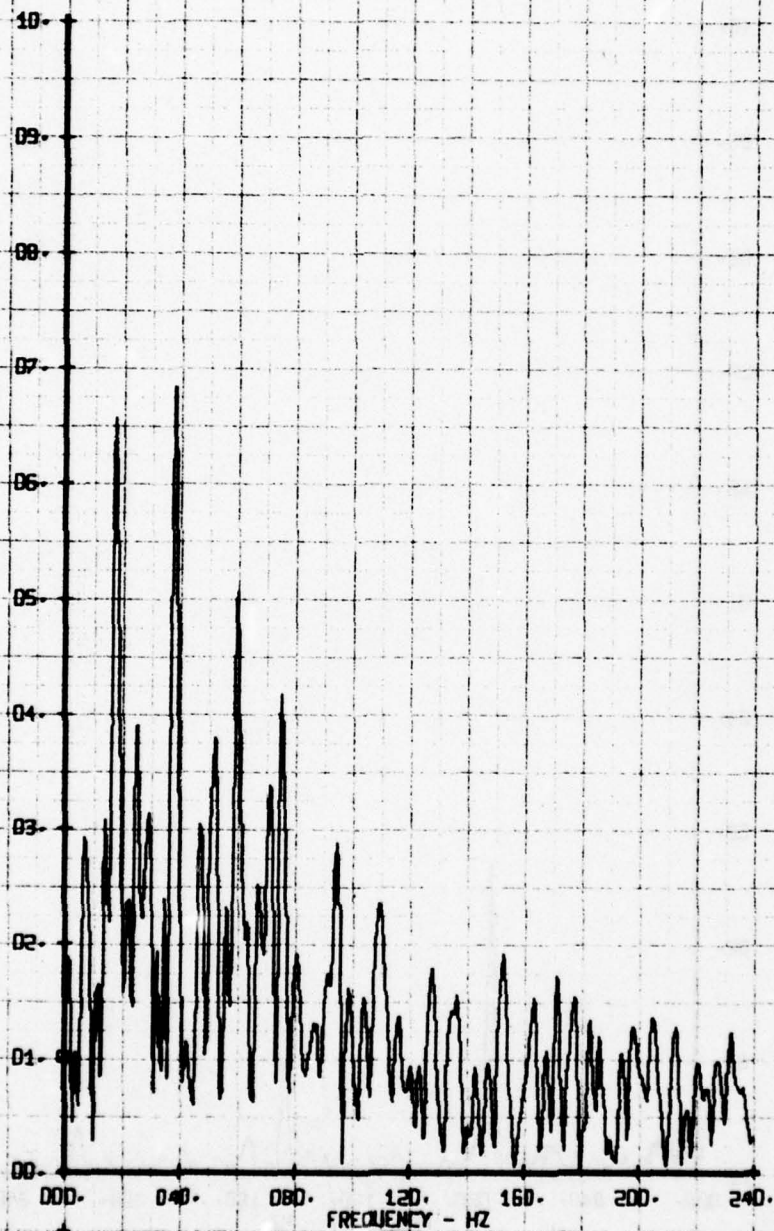
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 2

LEGEND
CH 65
PARAMETER
BETA

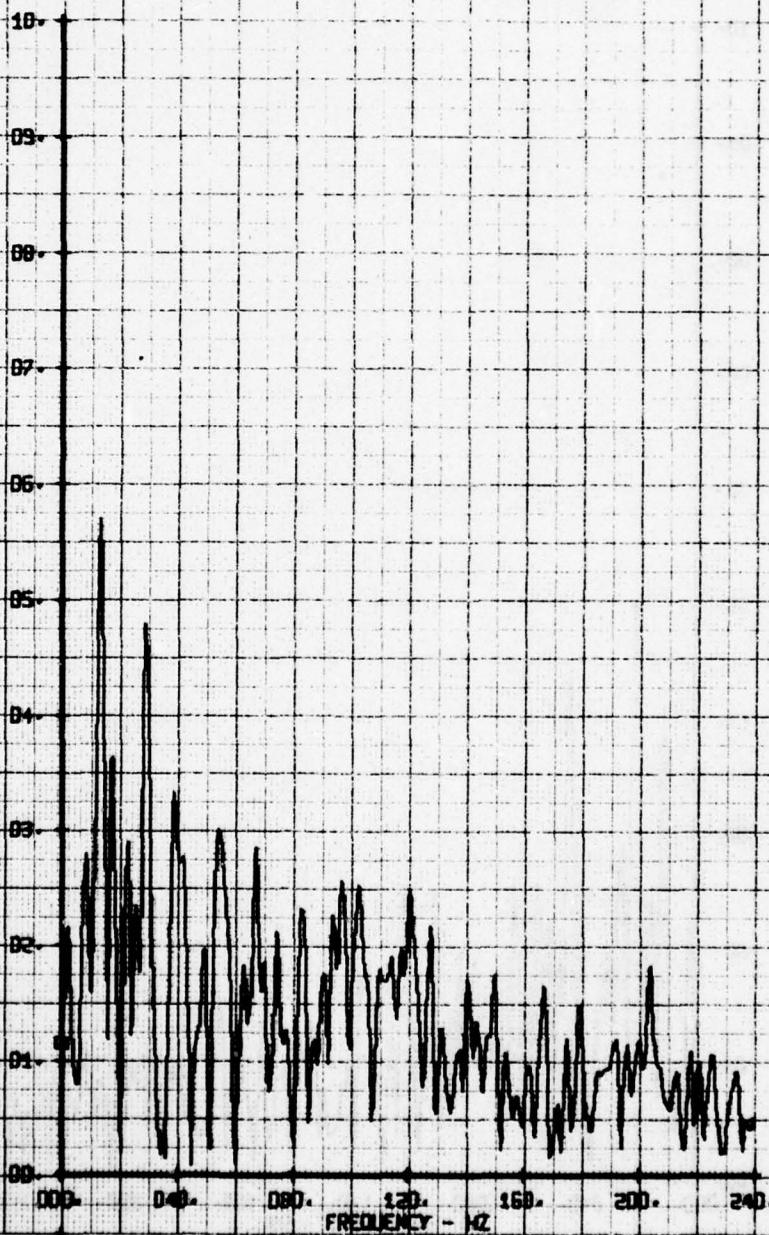
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 3

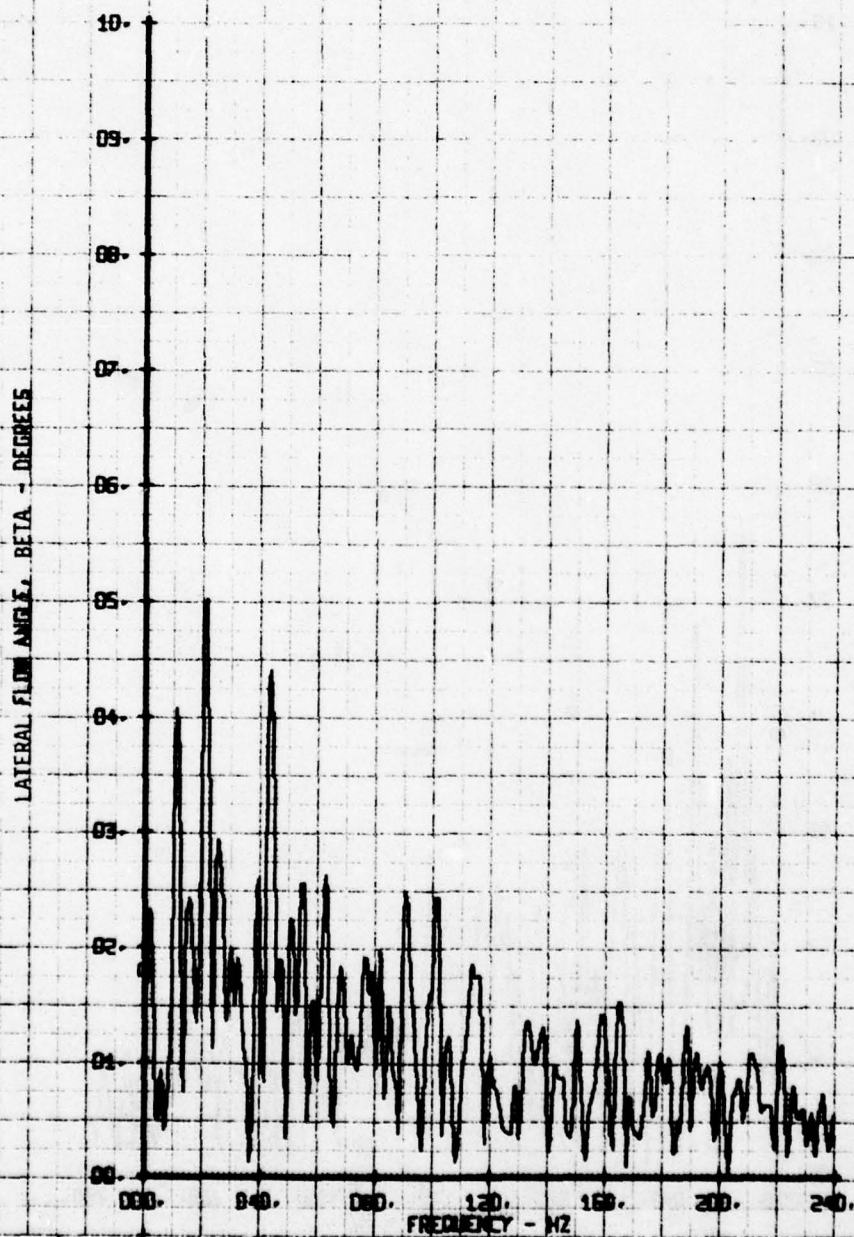
LEGEND
CH 65 PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



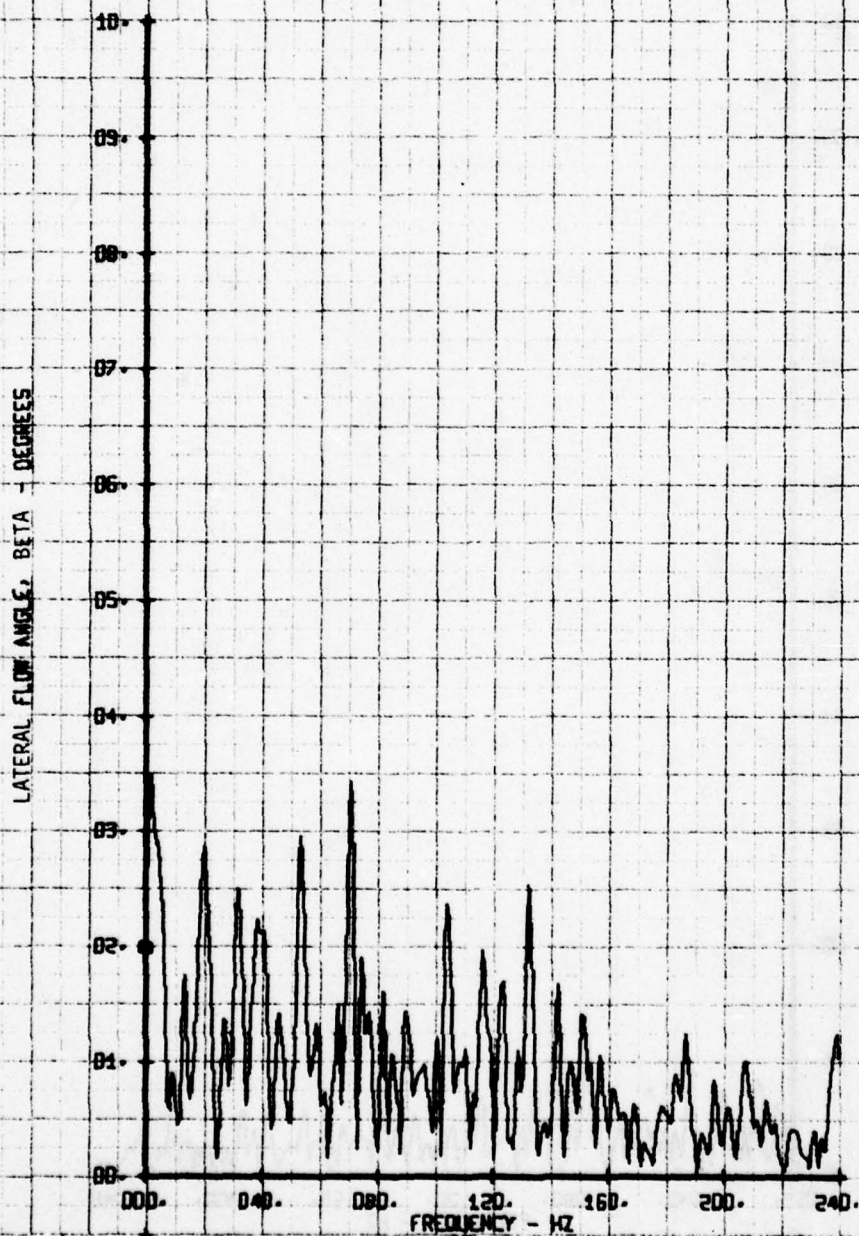
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 4

LEGEND
CH PARAMETER
65 BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 5

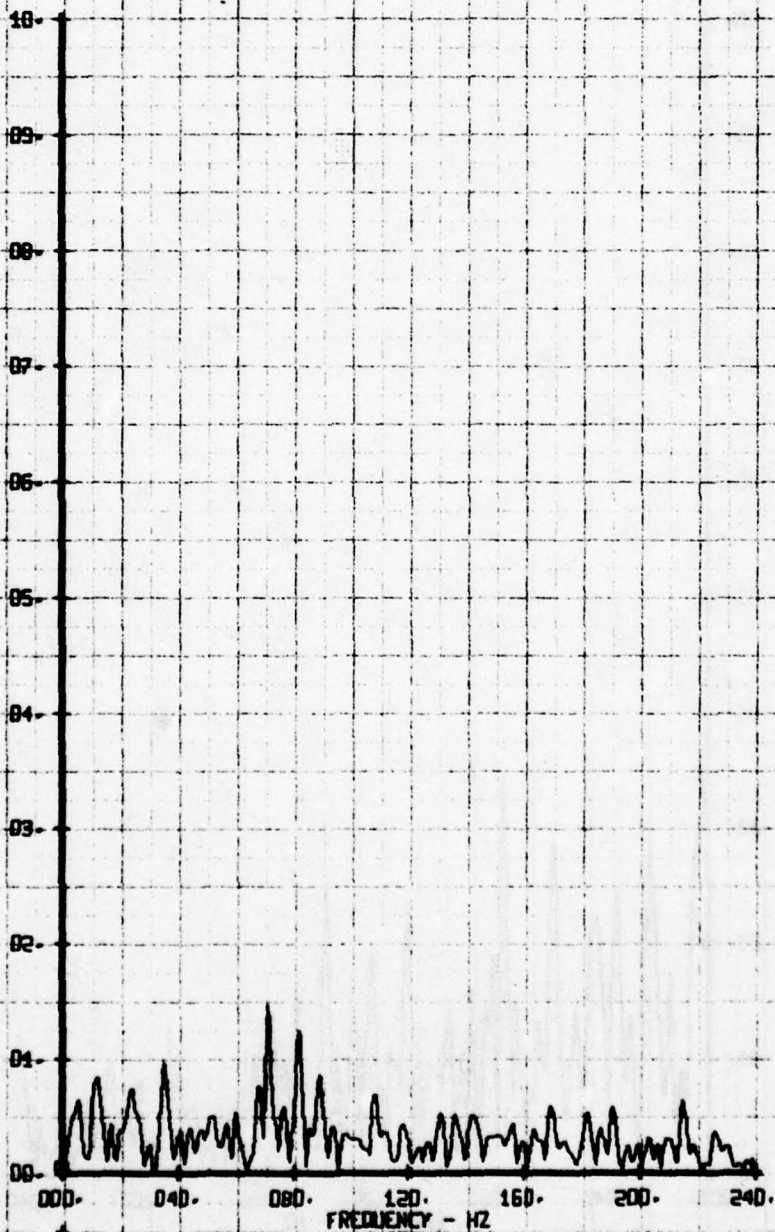
LEGEND
CH 65
PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES DEF
RUN 149 TP 6

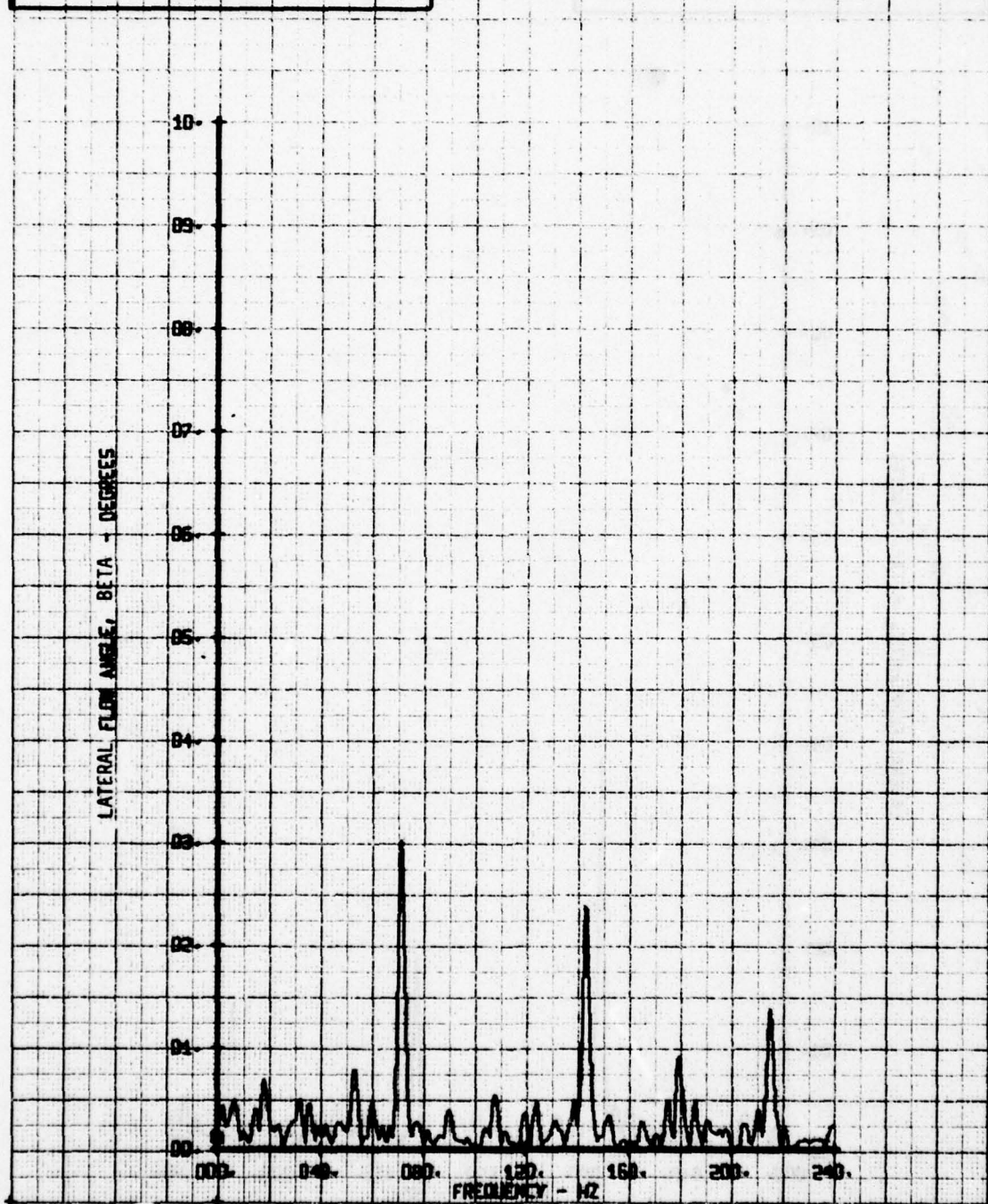
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



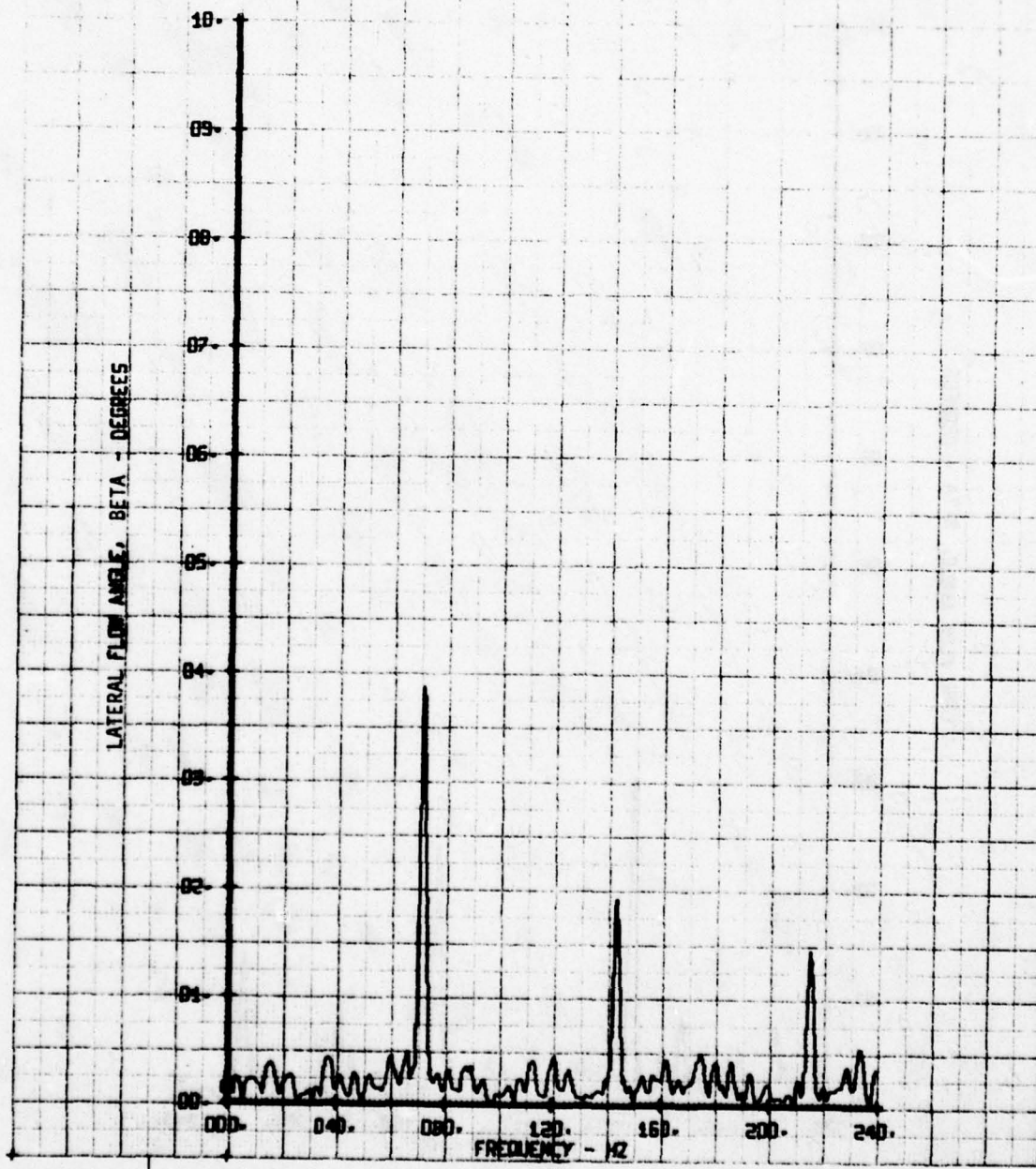
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP MACELLES DEE
RUN 14B TP 7

LEGEND
CH 65
PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 14B TP 8

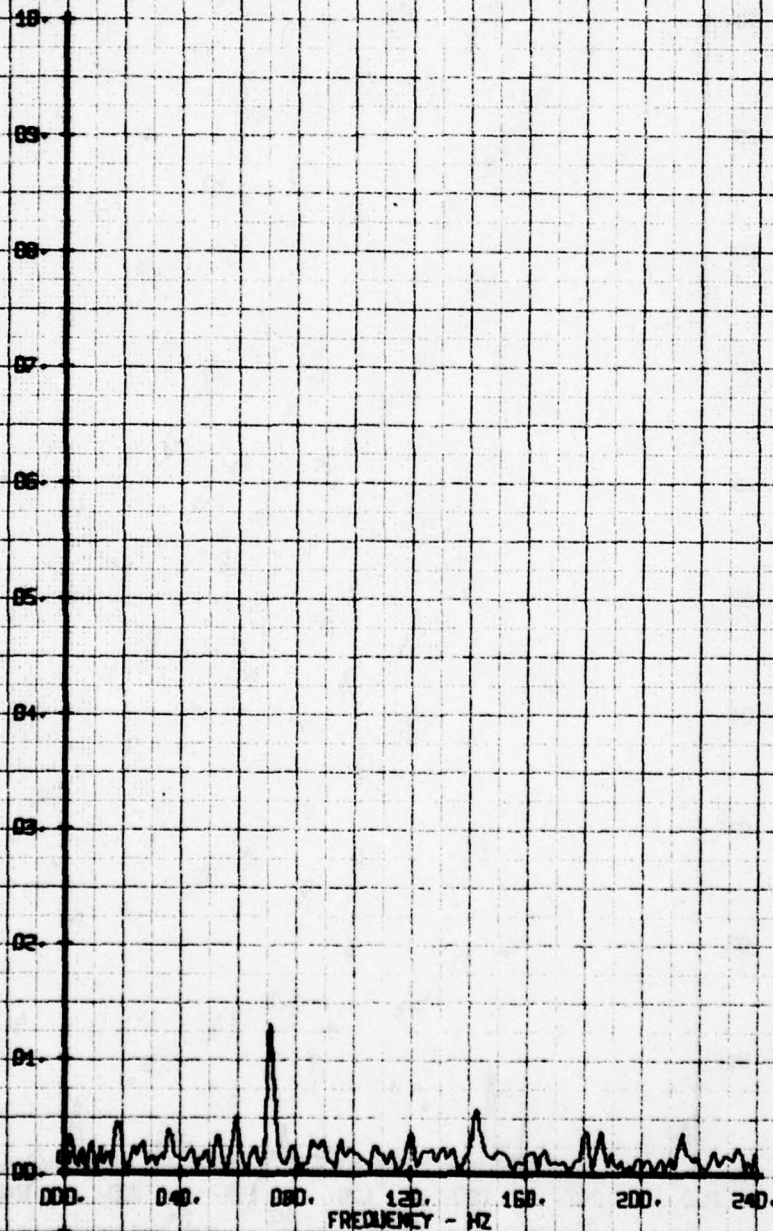
LEGEND
CH 65 PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP MODE/LS OFF
RUN 149 TP 3

LEGEND
CH PARAMETER
65 BETA

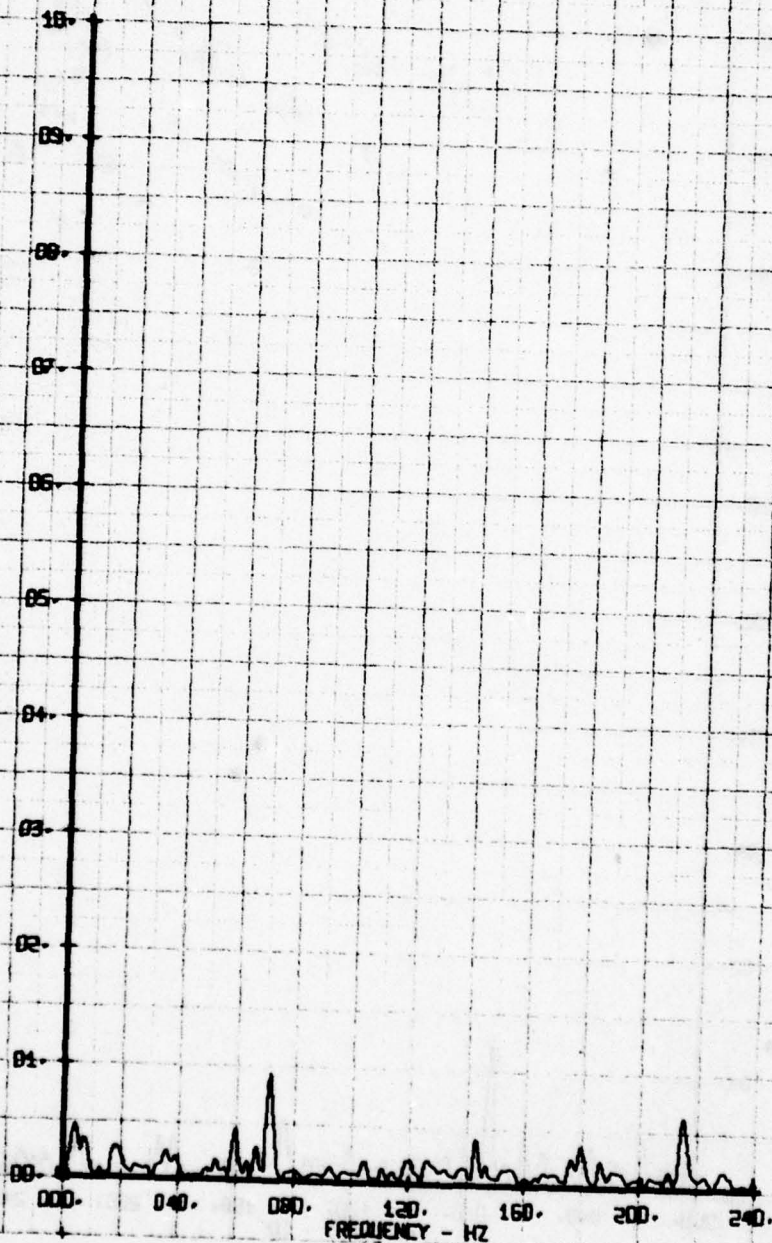
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 10

LEGEND
CH 65 PARAMETER
BETA

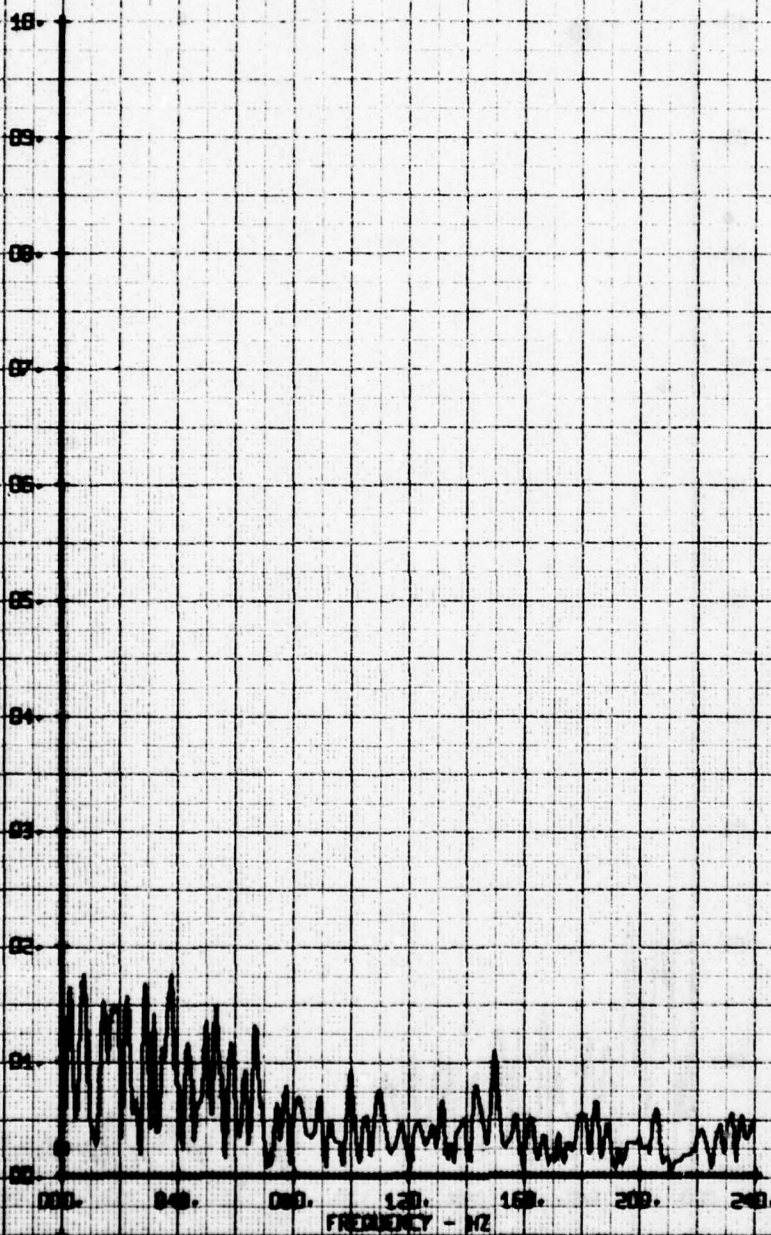
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 2

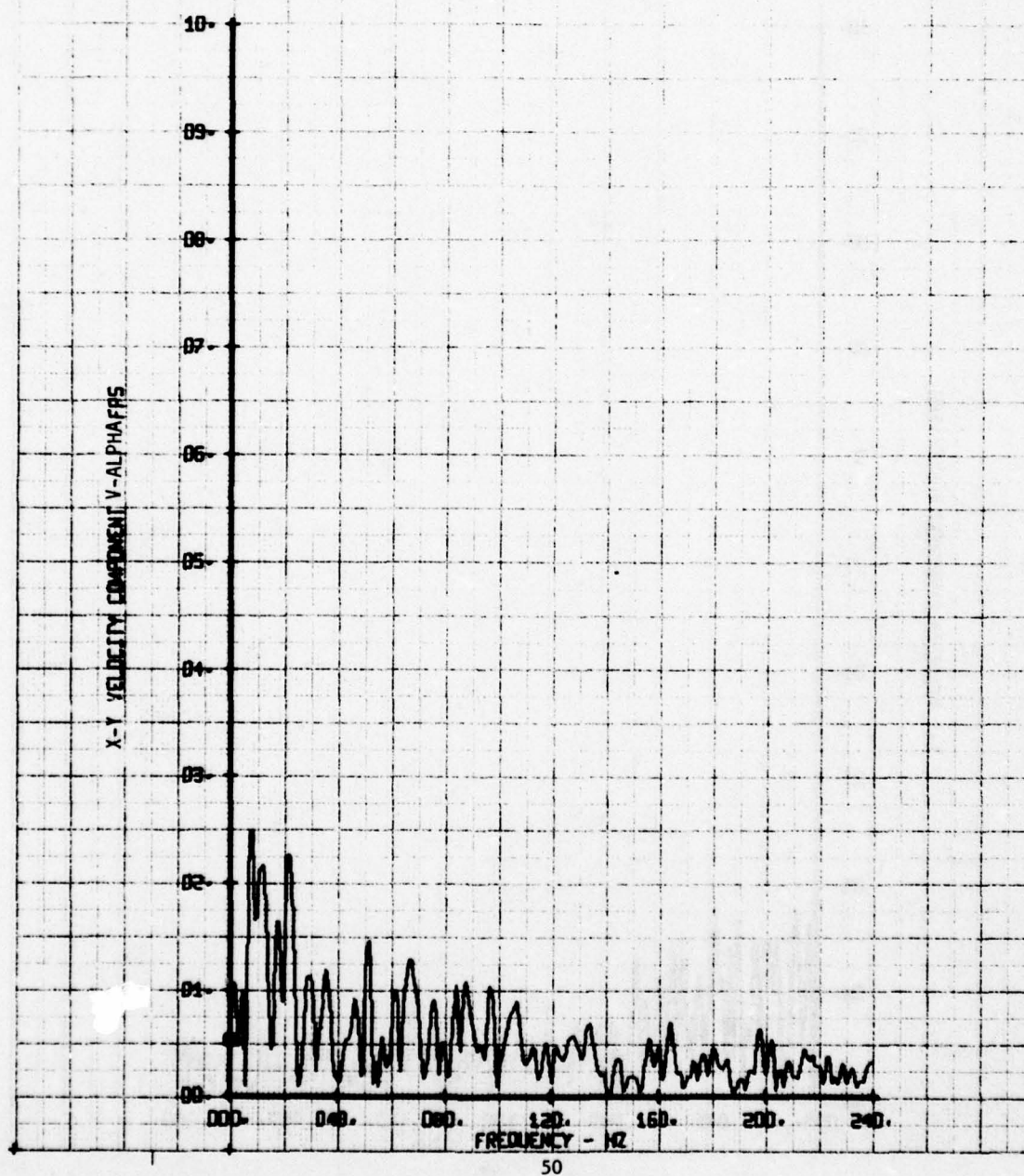
LEGEND
CH 66
PARAMETER
V-ALPHA

X-Y VELOCITY COMPONENT V-ALPHAERS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 3

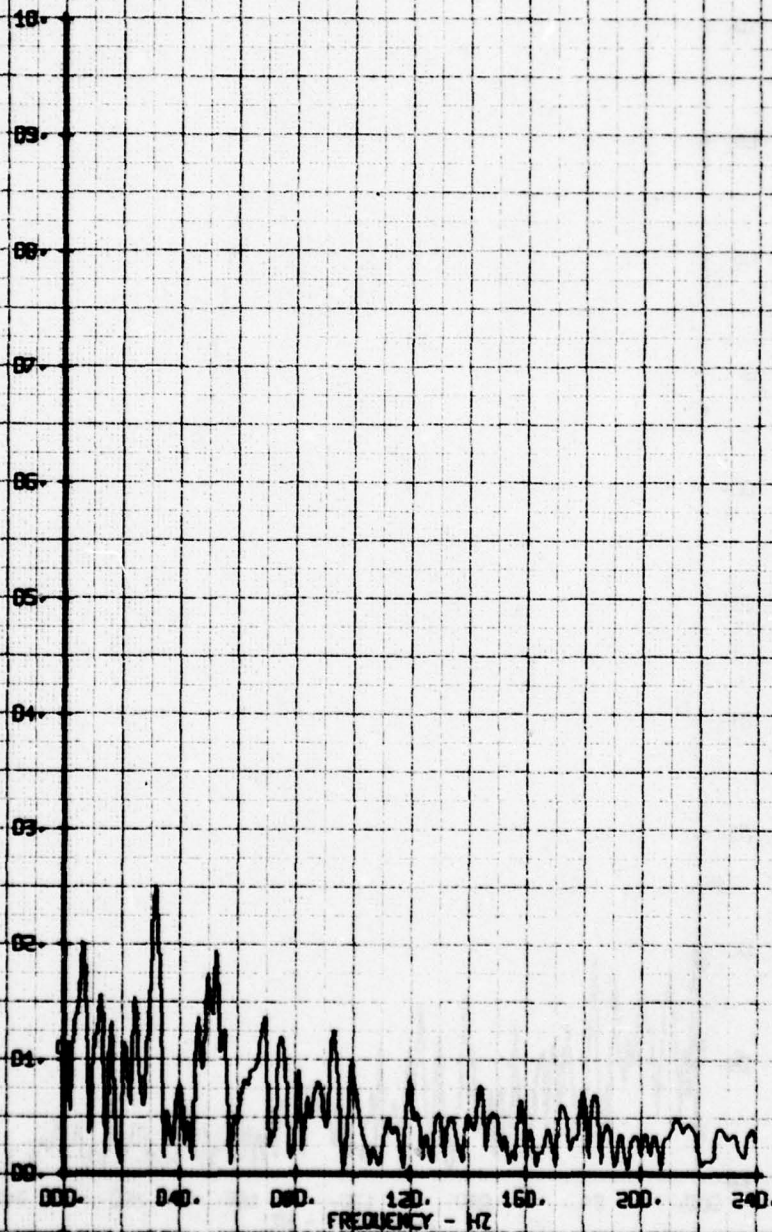
LEGEND
CH 66
PARAMETER
V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 4

LEGEND
CH 56 PARAMETER
V-ALPHA

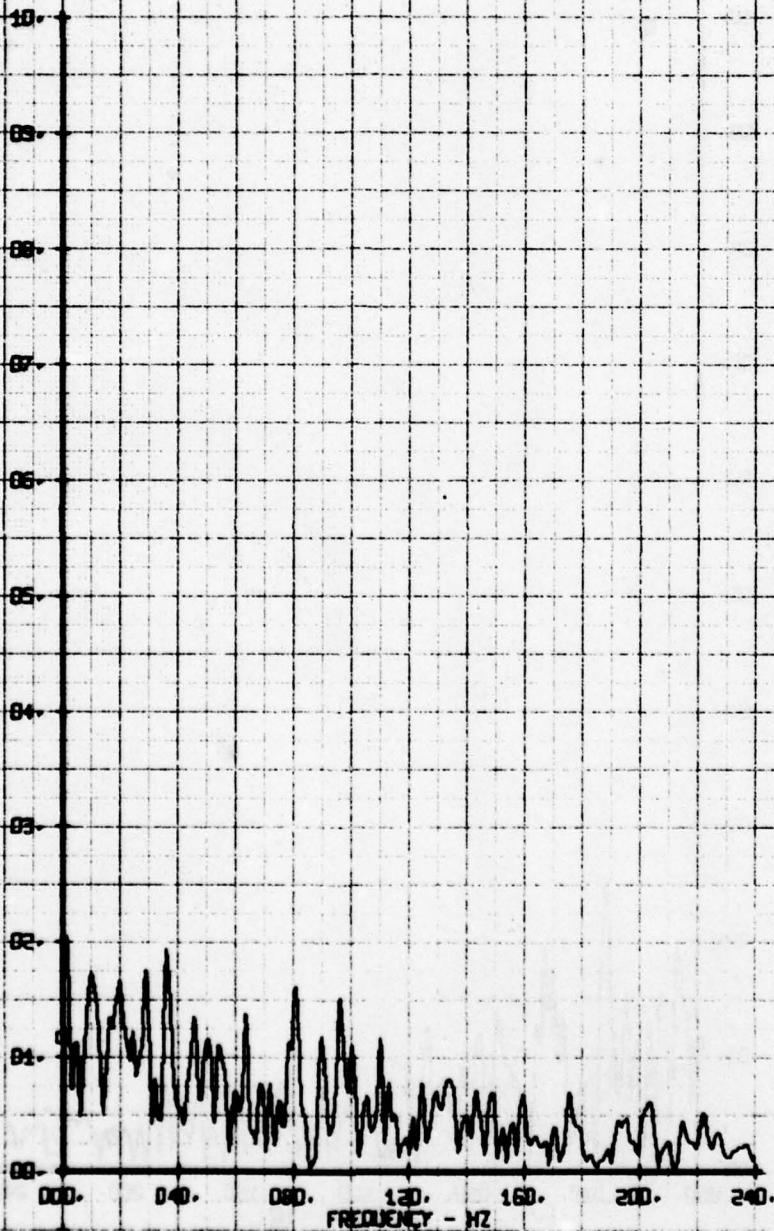
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NOZZLES OFF
RUN 149 TP 5

LEGEND
CN 66
PARAMETER
V-ALPHA

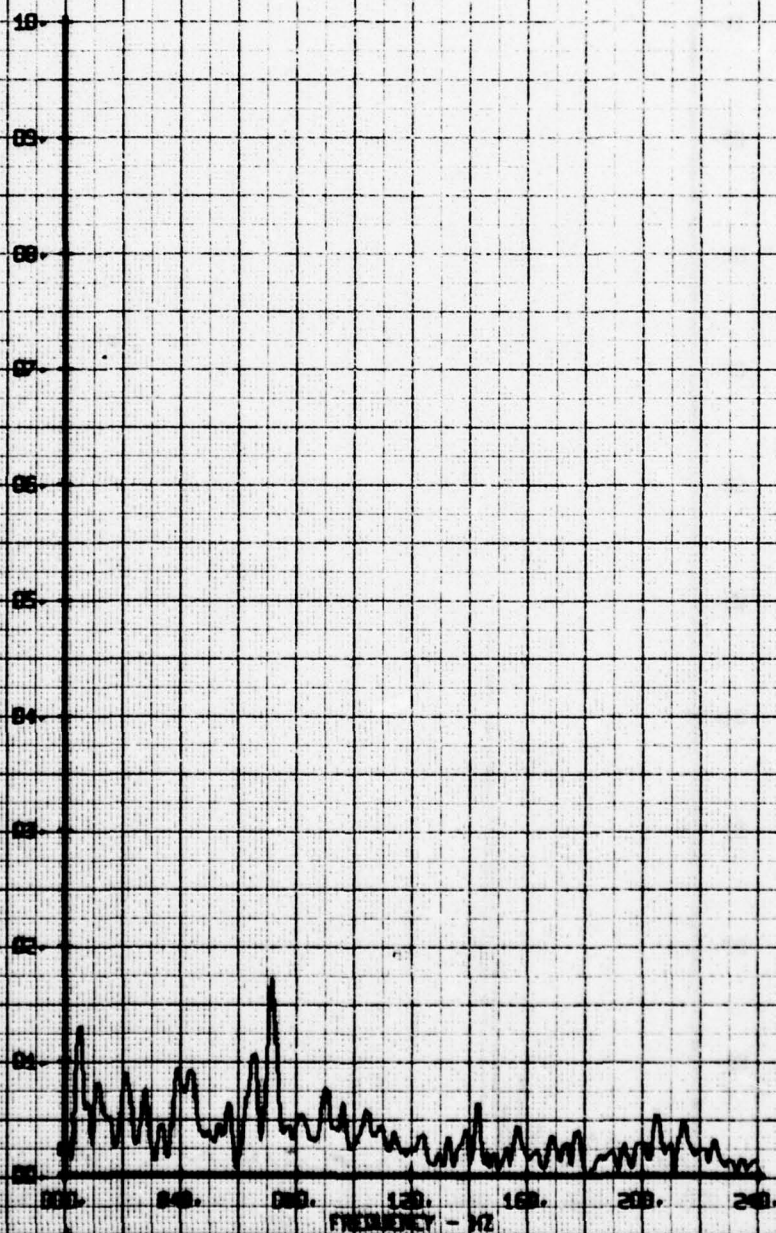
X-Y VELOCITY COMPONENT V-ALPHAERS



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLERS DEF
RUN 149 TP 6

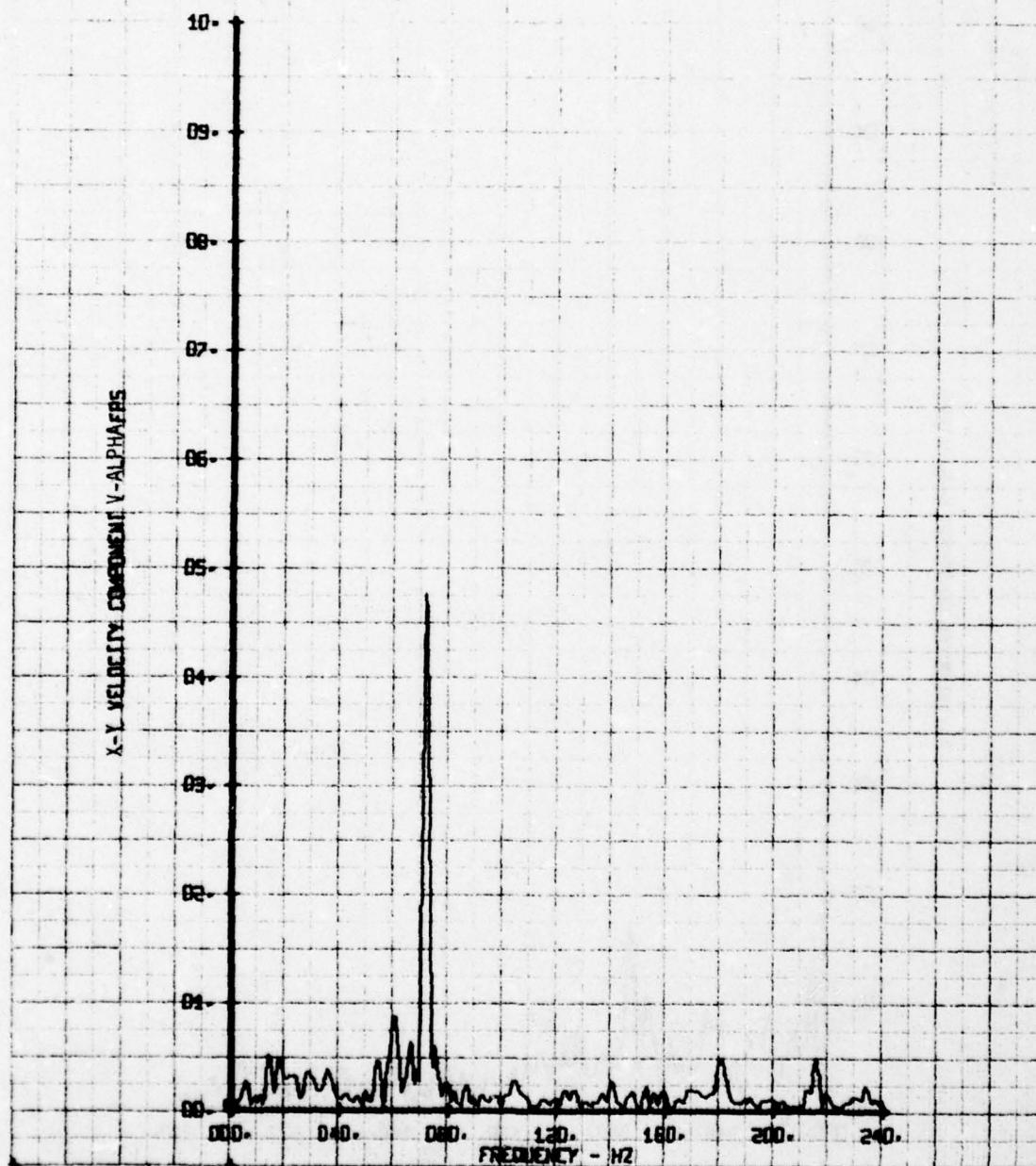
LEGEND
CH 66 PARAMETER
V-ALPHA

X-Y PLANEITY COMPONENT V-ALPHAS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 7

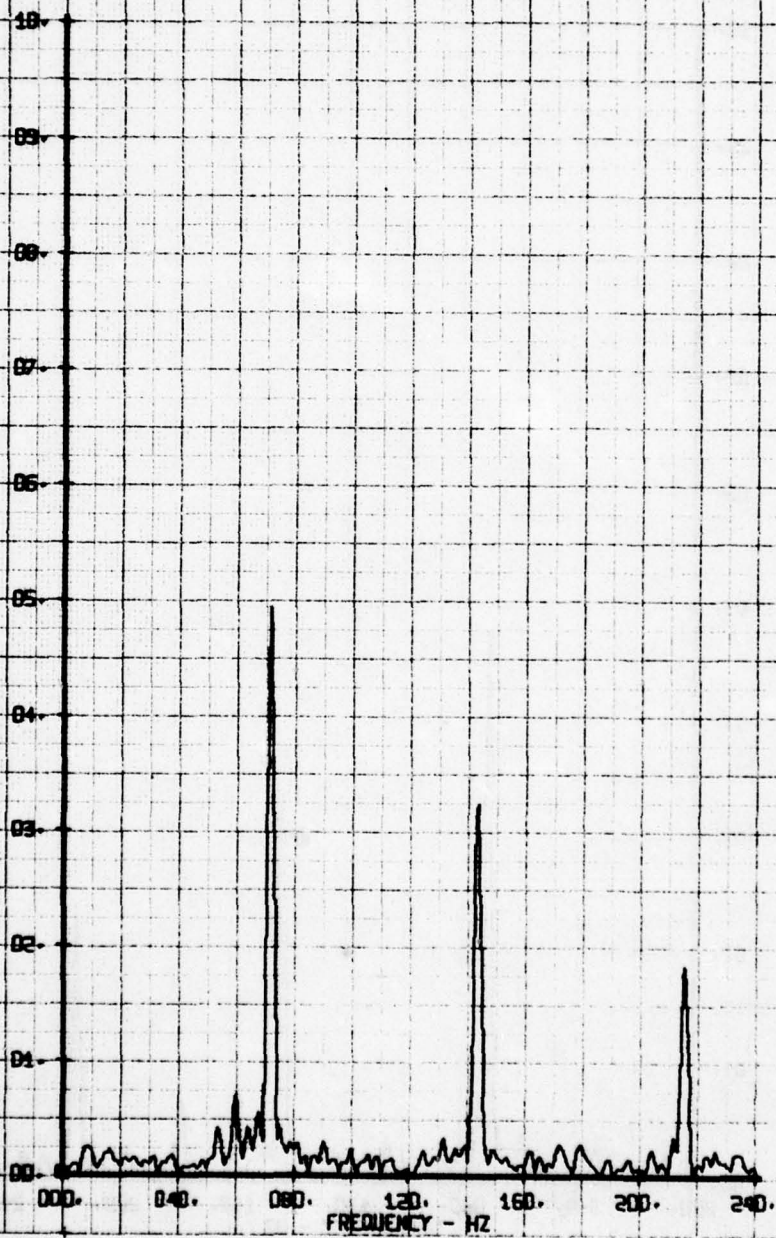
LEGEND
CH PARAMETER
66 V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 8

LEGEND
CH 66
PARAMETER
V-ALPHA

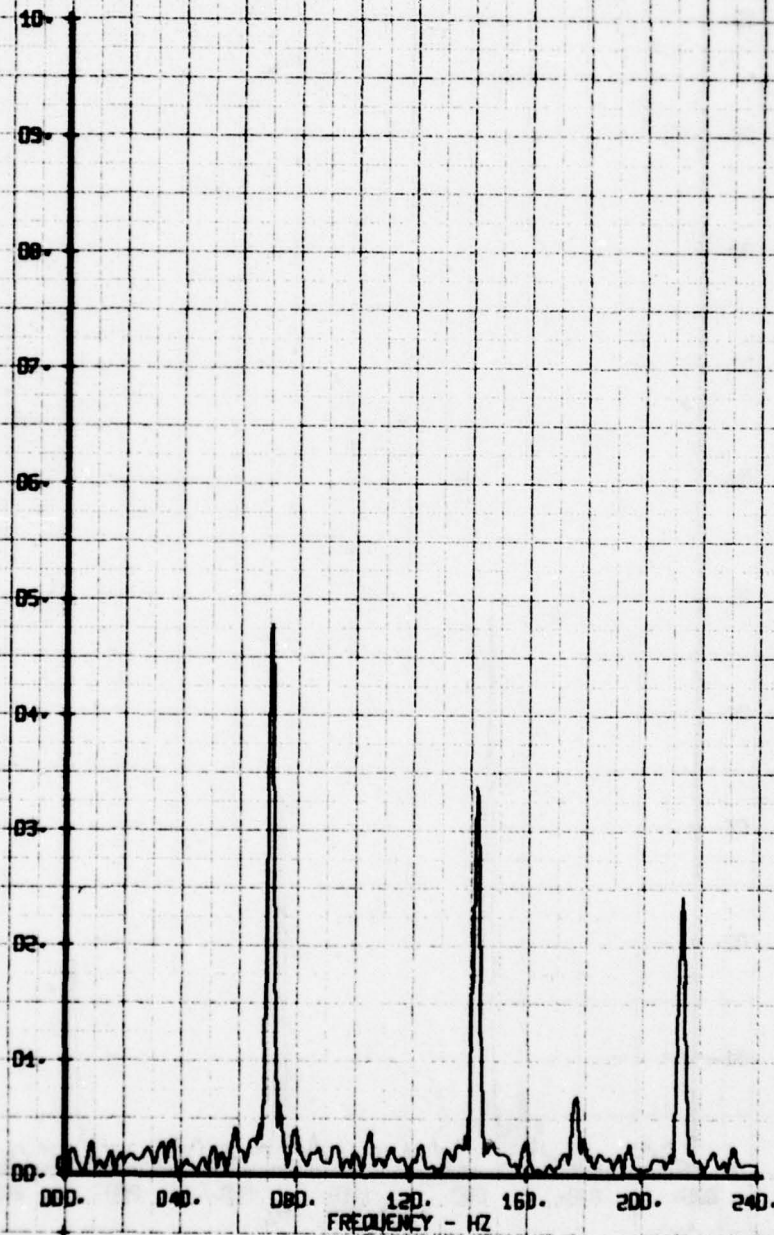
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES DEF
RUN 149 TP 9

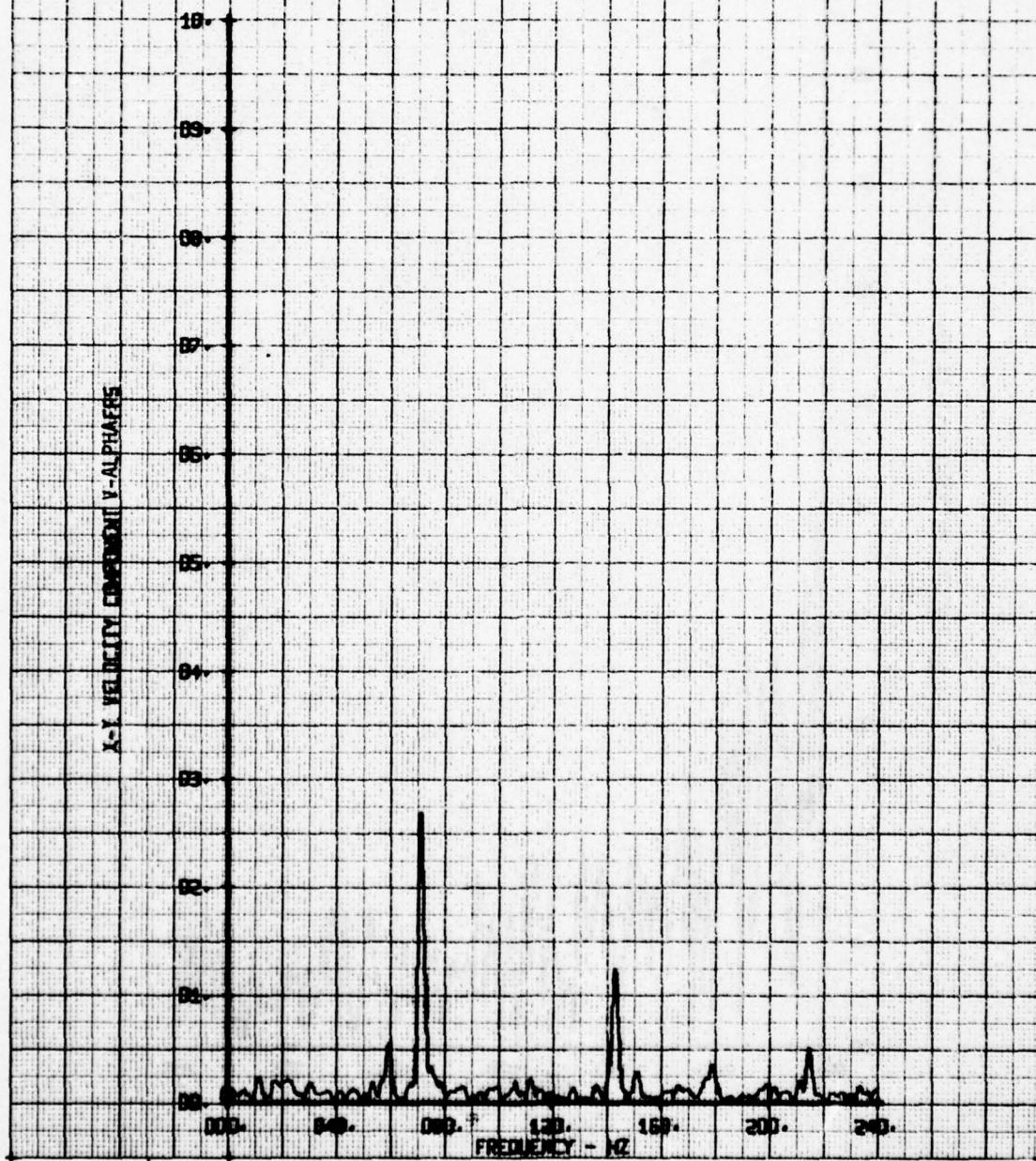
LEGEND
CH 56
PARAMETER
V-ALPHA

X-Y VELOCITY COMPONENT V-ALPHA FRS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES DEF
RUN 149 TP 10

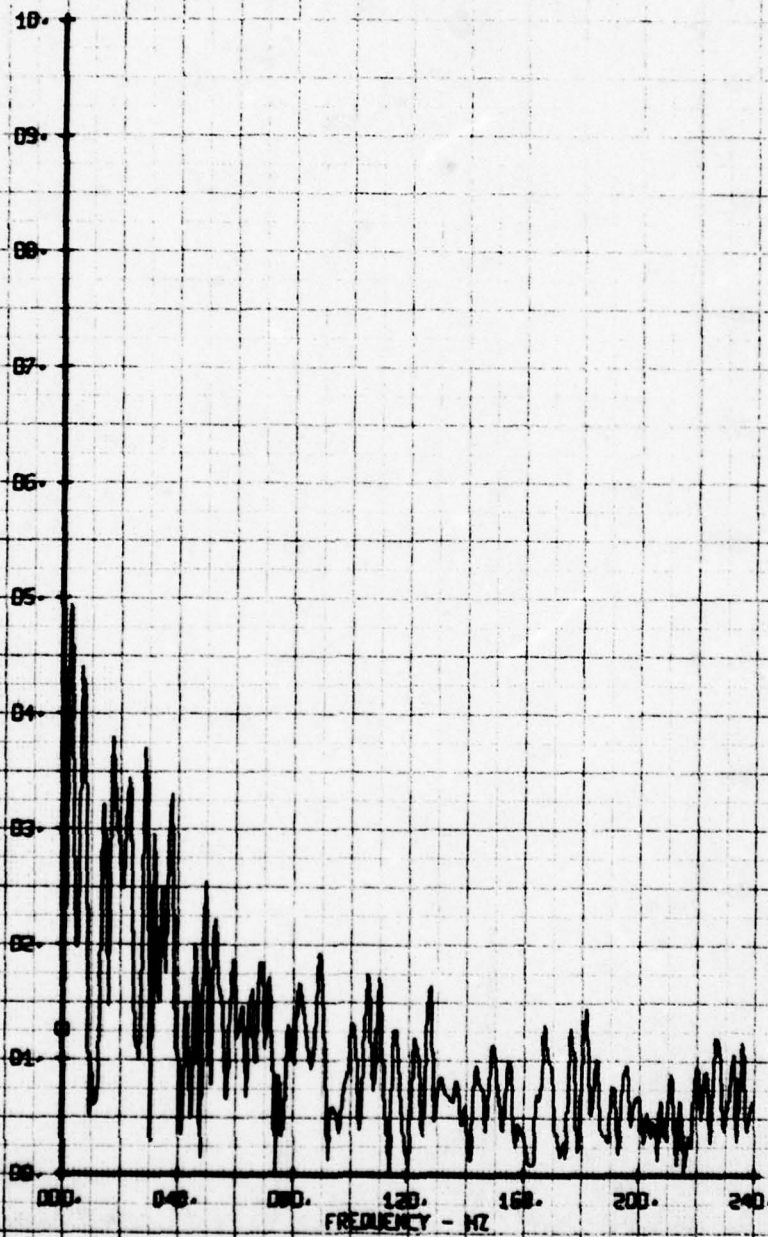
LEGEND
CH 66
PARAMETER
V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 2

LEGEND
CH 65
PARAMETER
V-BETA

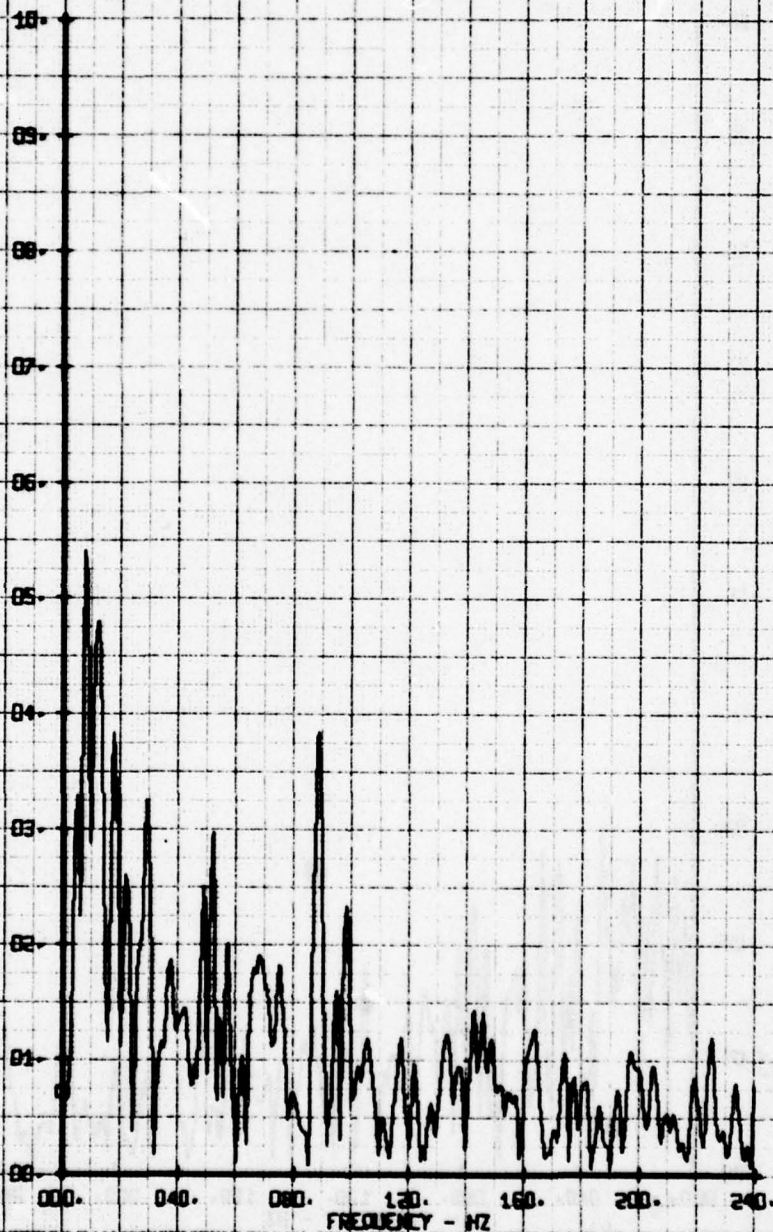
X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 3

LEGEND
CH 65
PARAMETER
V-BETA

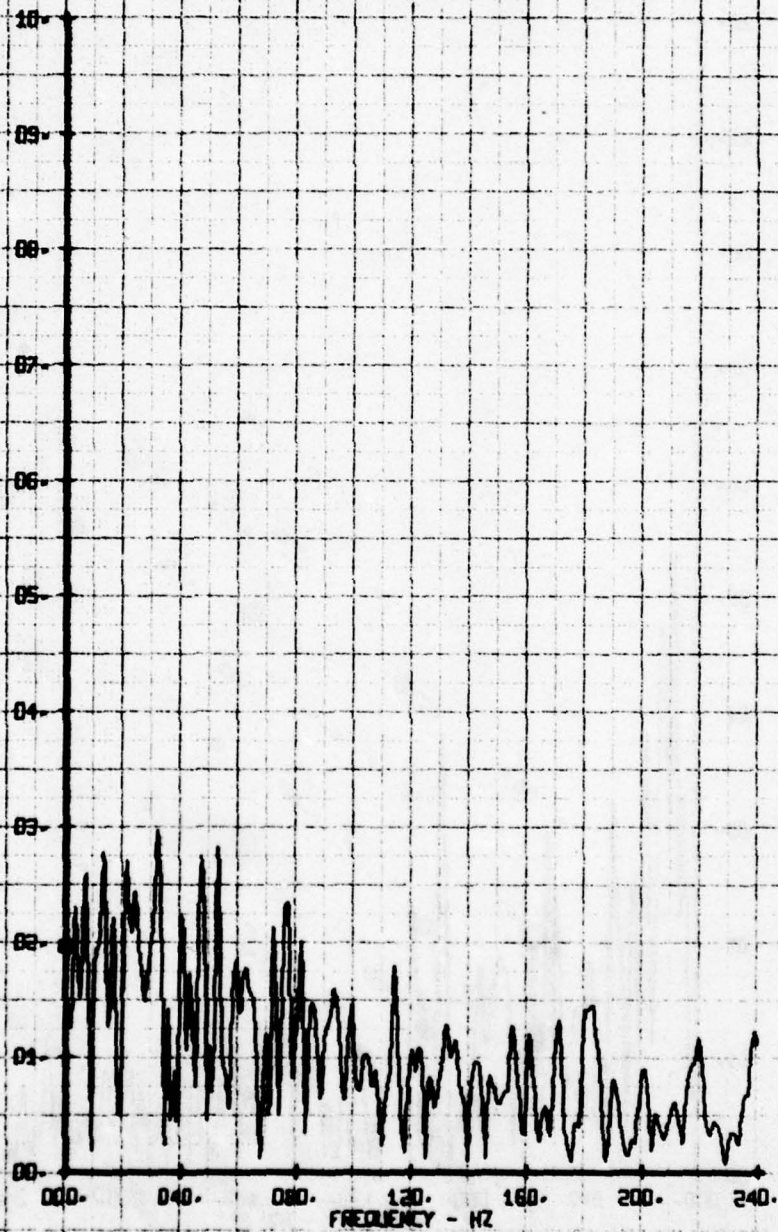
X-Z VELOCITY COMPONENT V-BETA RMS



HOT FILM WIRE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELL 15 DEF
RUN 149 IP 4

LEGEND
CH 65
PARAMETER
V-BETA

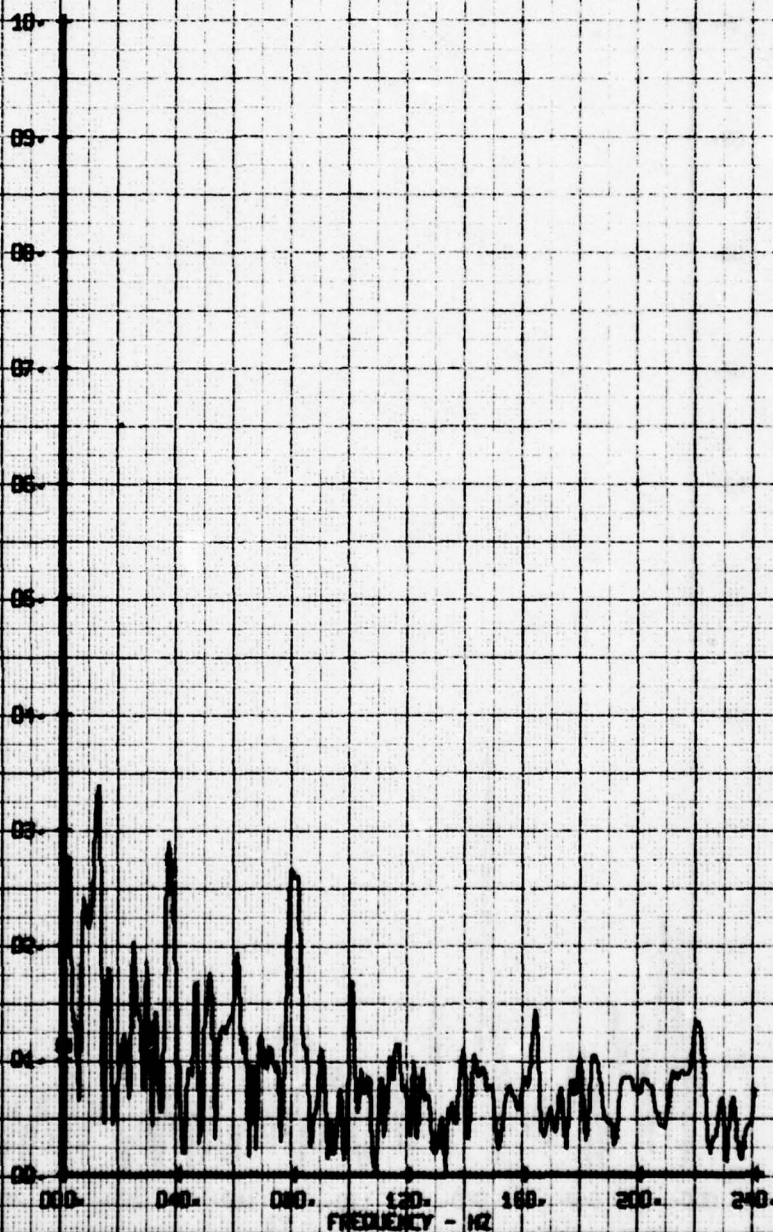
X-Z VELOCITY COMPONENT V-BETA RMS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLE OFF
RUN 149 TP 5

LEGEND
CH 65 PARAMETER
V-BETA

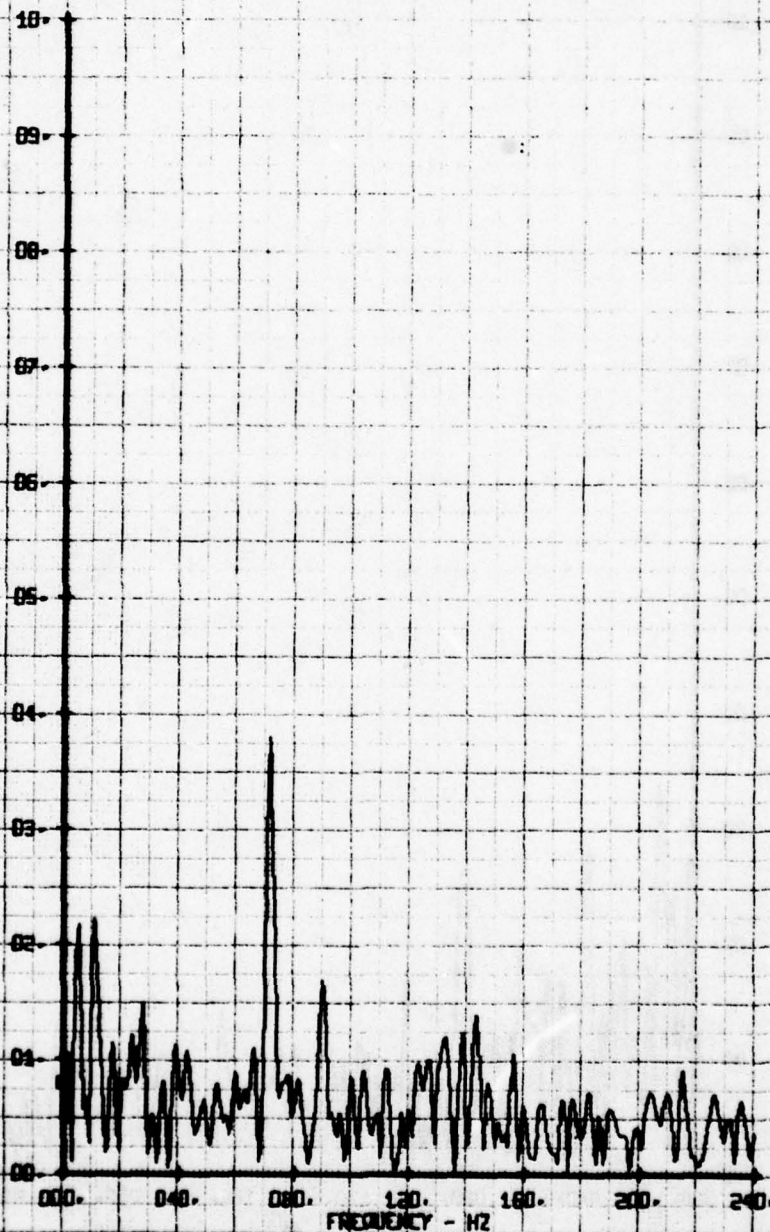
X-Z VELOCITY COMPONENT V-BETA RMS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 6

LEGEND
CH PARAMETER
65 V-BETA

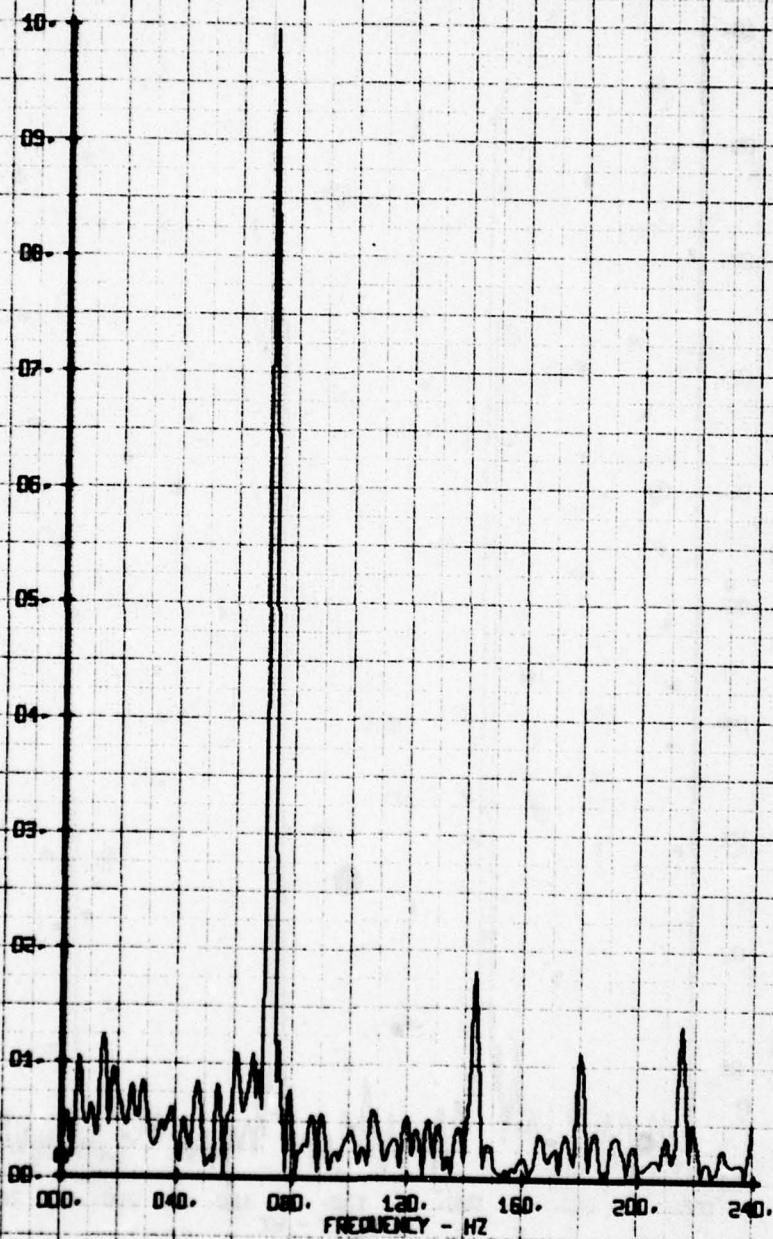
X-Z VELOCITY COMPONENT V-BETA RMS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES DEF
RUN 149 IP 7

LEGEND
CH 65
PARAMETER
V-BETA

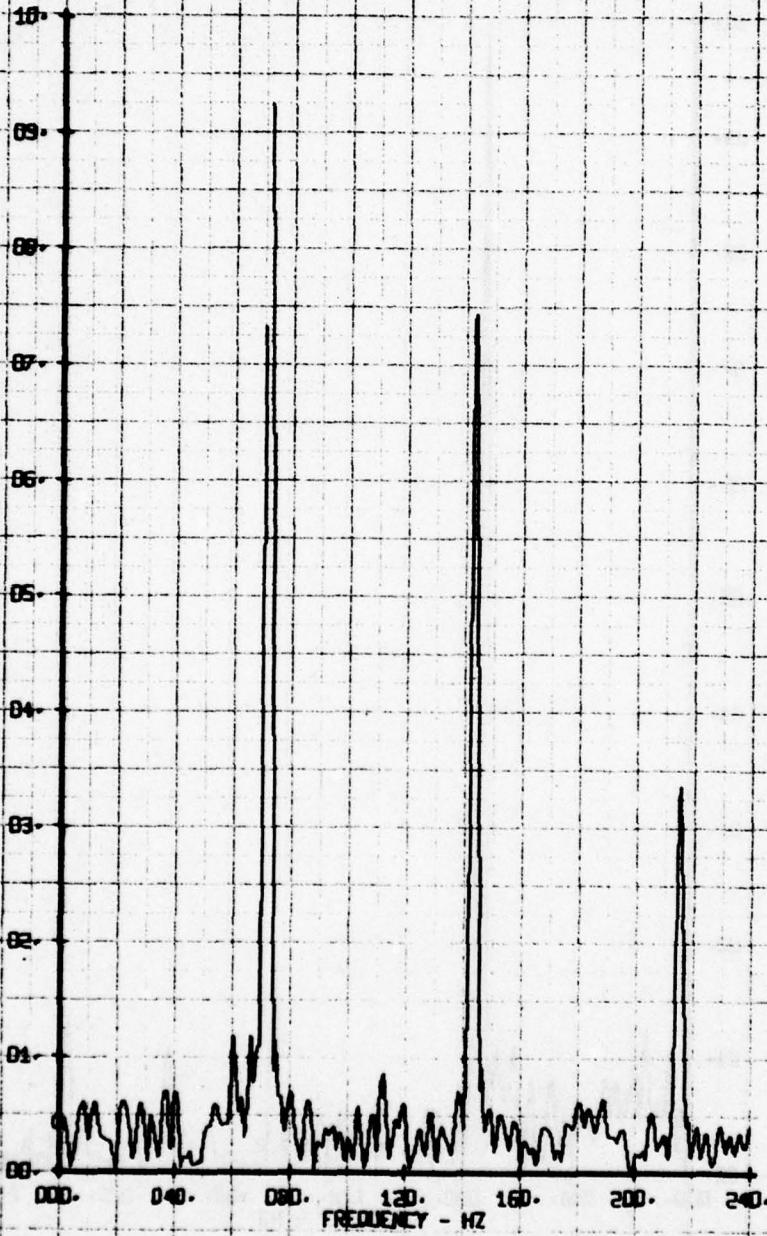
X-Z VELOCITY COMPONENT V-BETA RMS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 143 TP 8

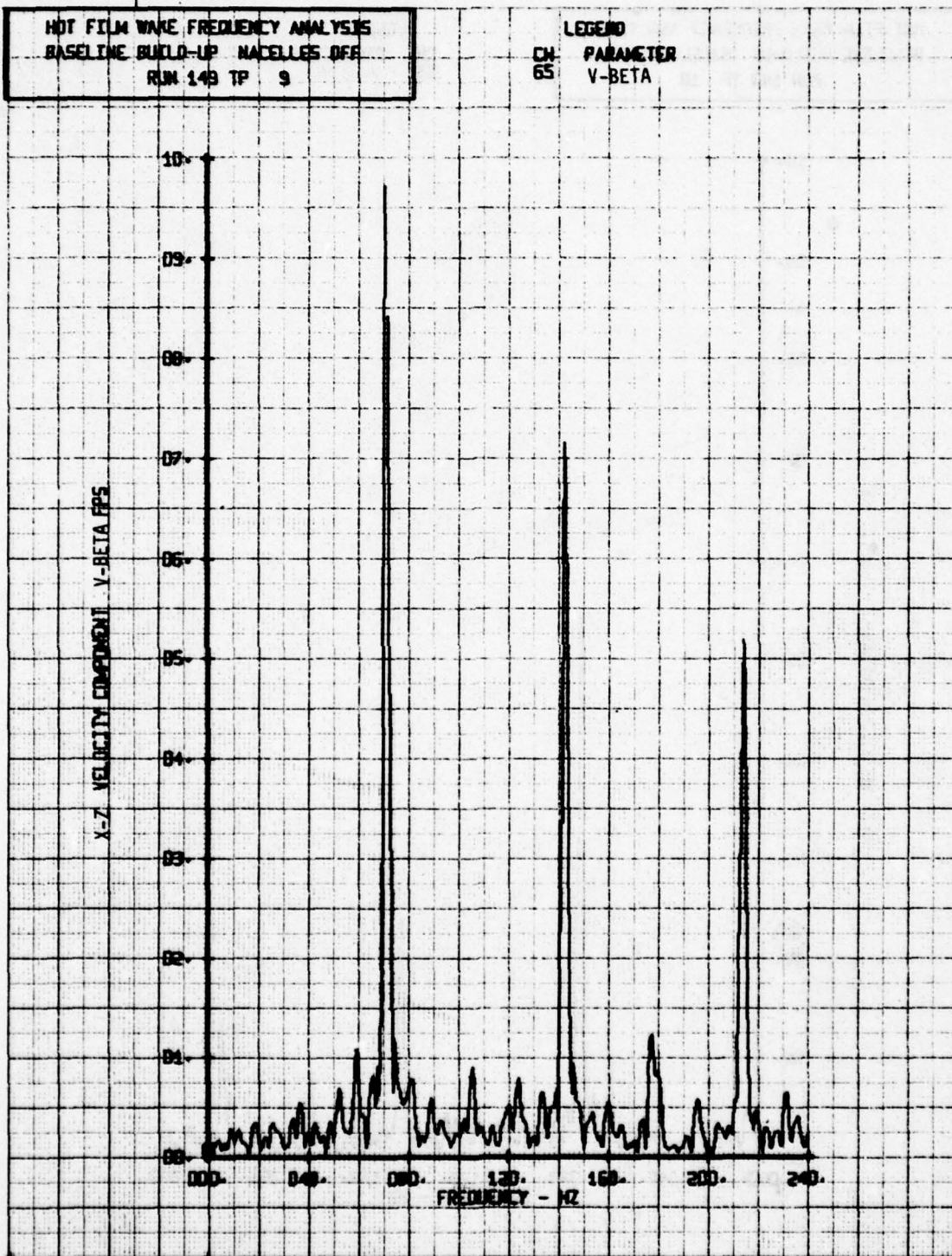
LEGEND
CH 65 PARAMETER
V-BETA

X-Z VELOCITY COMPONENT V-BETA PPS



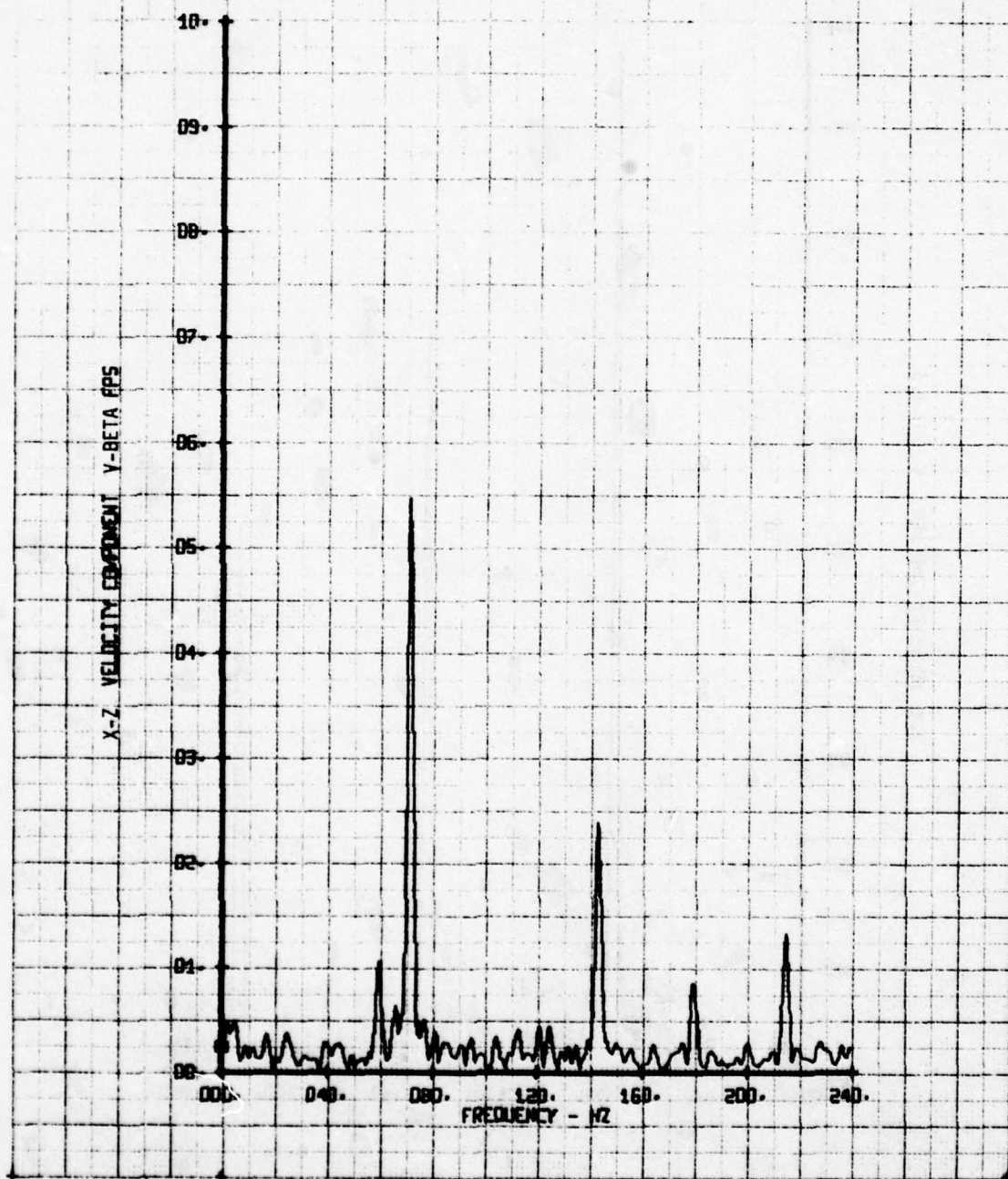
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 9

LEGEND
CH 65 PARAMETER
V-BETA



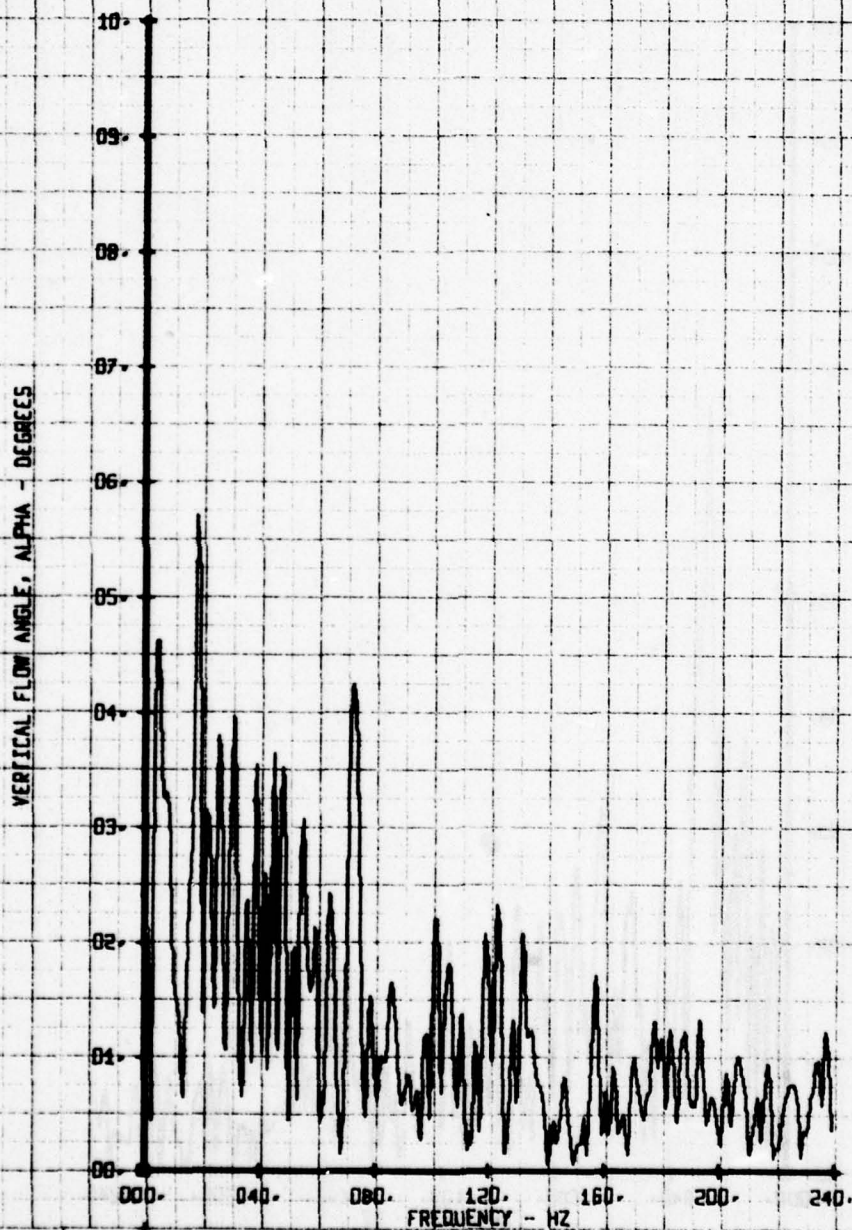
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BUILD-UP NACELLES OFF
RUN 149 TP 10

LEGEND
CH 65 PARAMETER
V-BETA



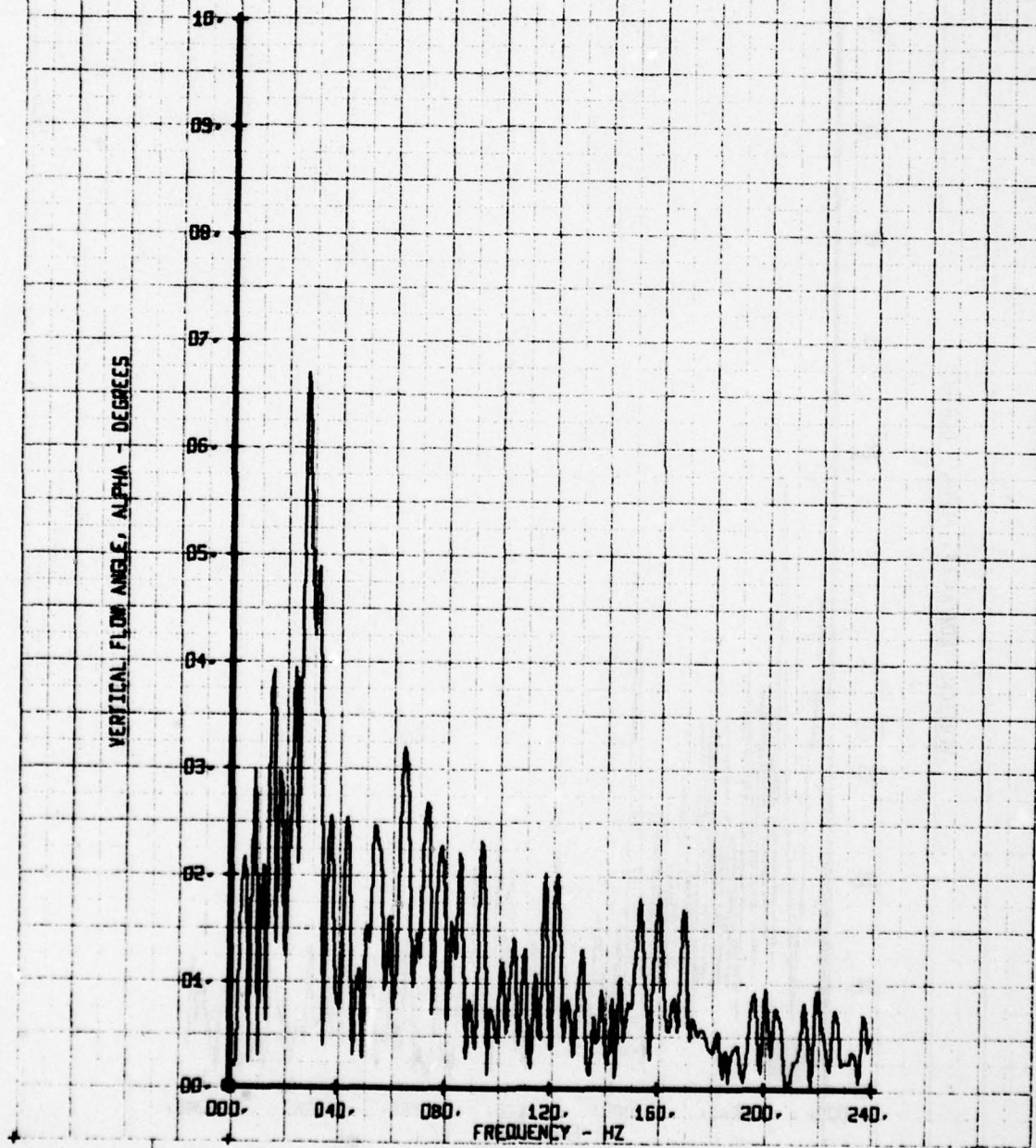
NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 6000
RUN 150 TP 2

LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 3

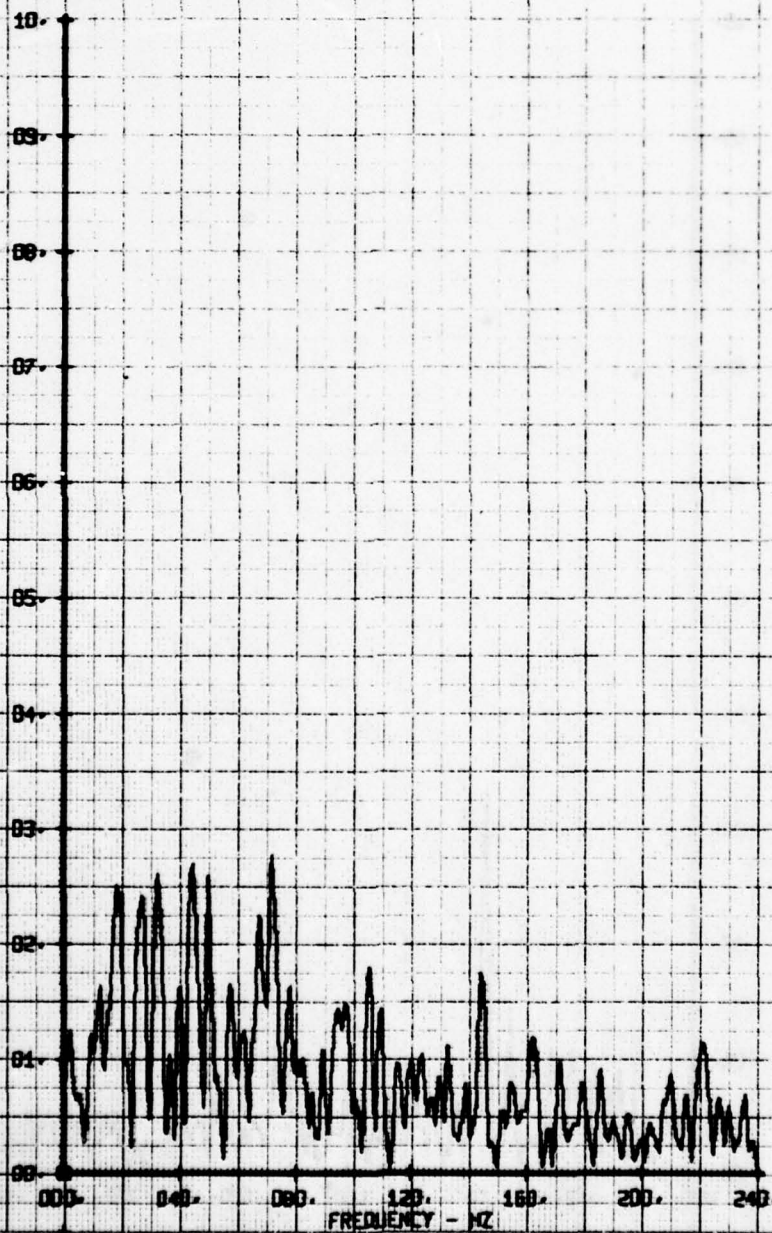
LEGEND
CH. 56 PARAMETER
56 ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 4

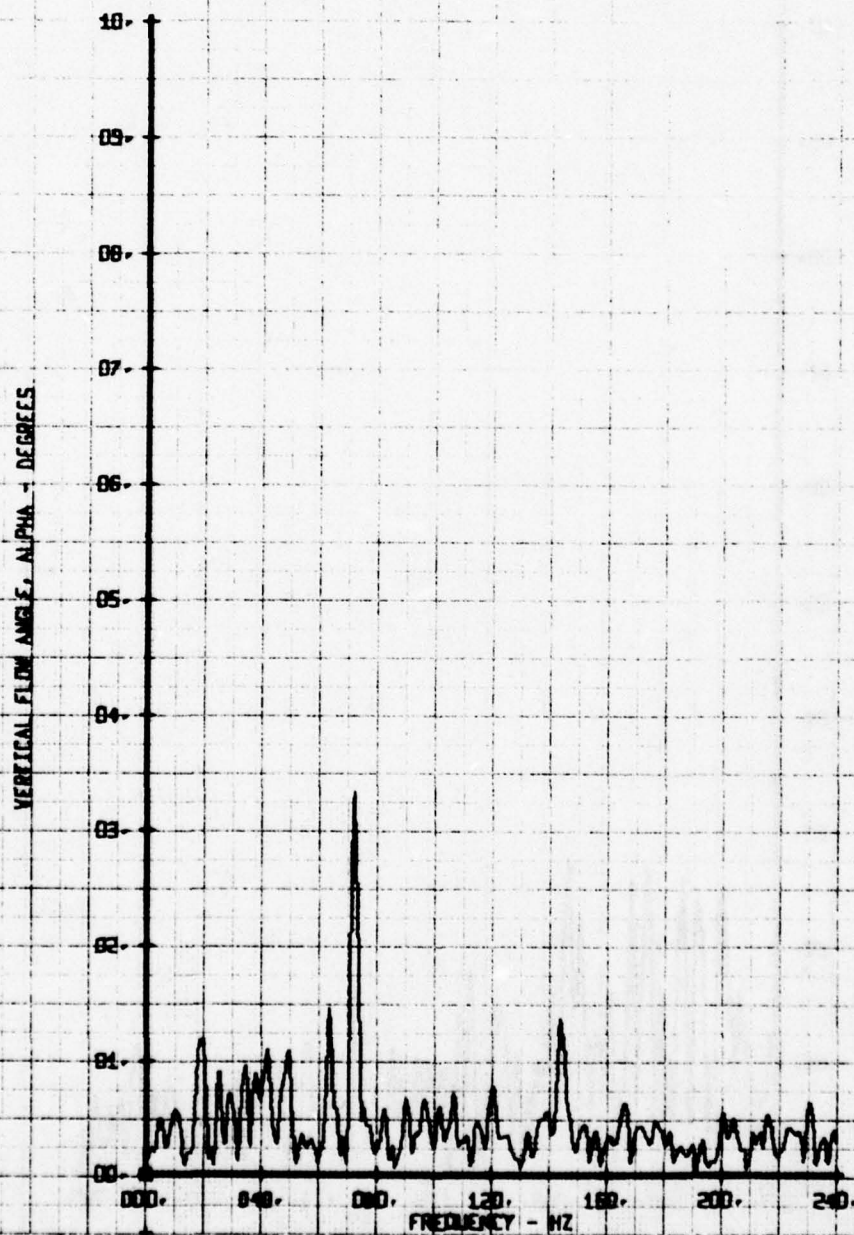
LEGEND
CH 66 PARAMETER
ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 5

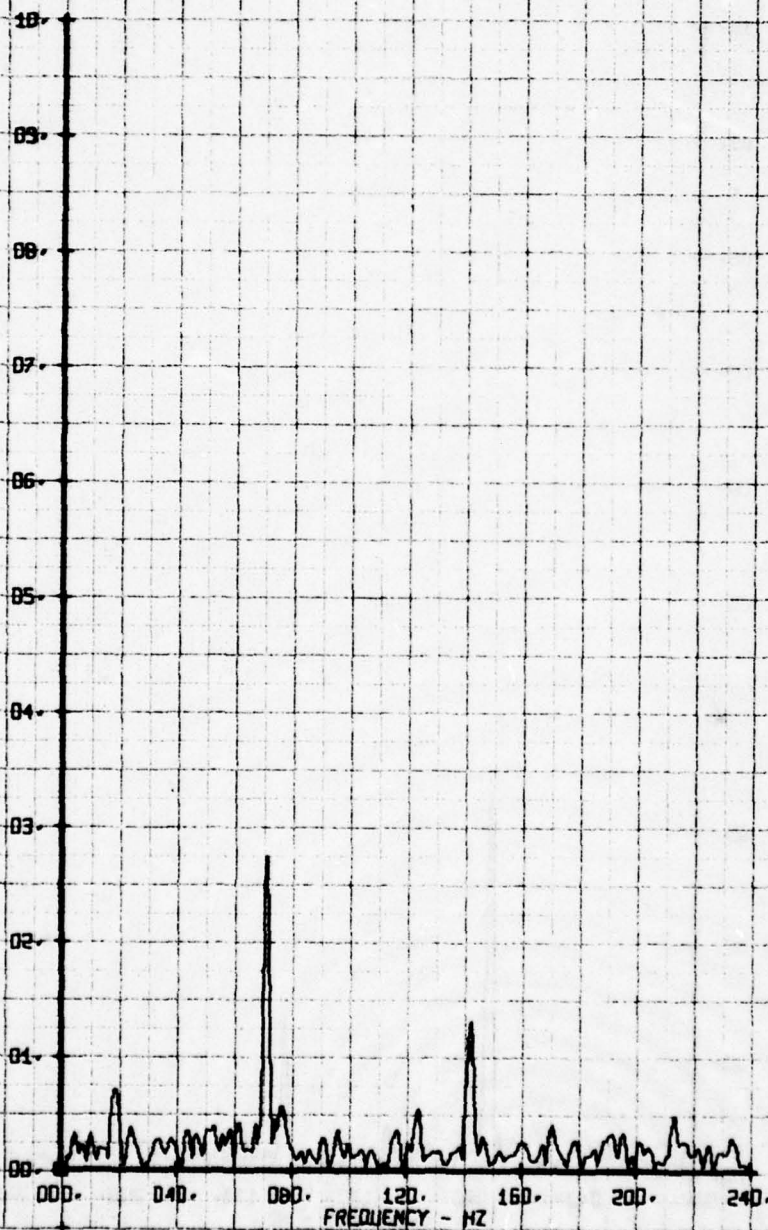
LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 6

LEGEND
CH 66 PARAMETER
ALPHA

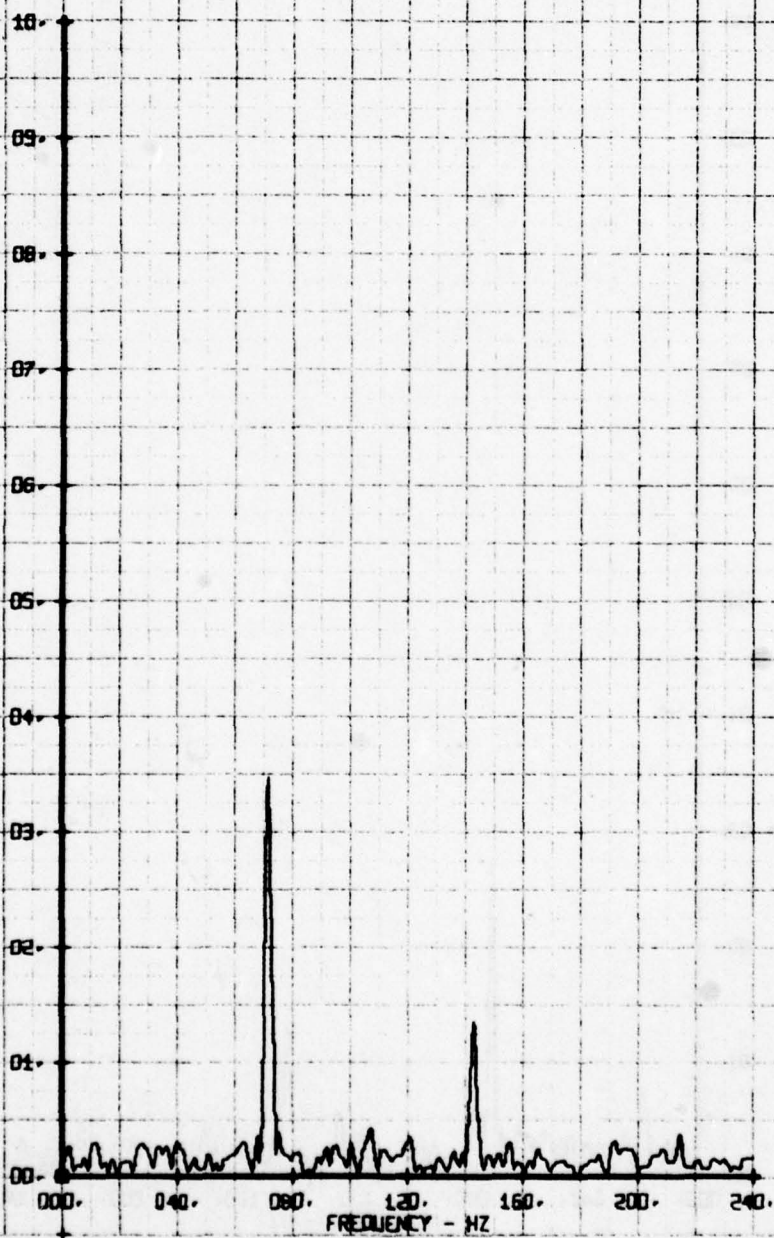
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 7

LEGEND
CH 66 PARAMETER
66 ALPHA

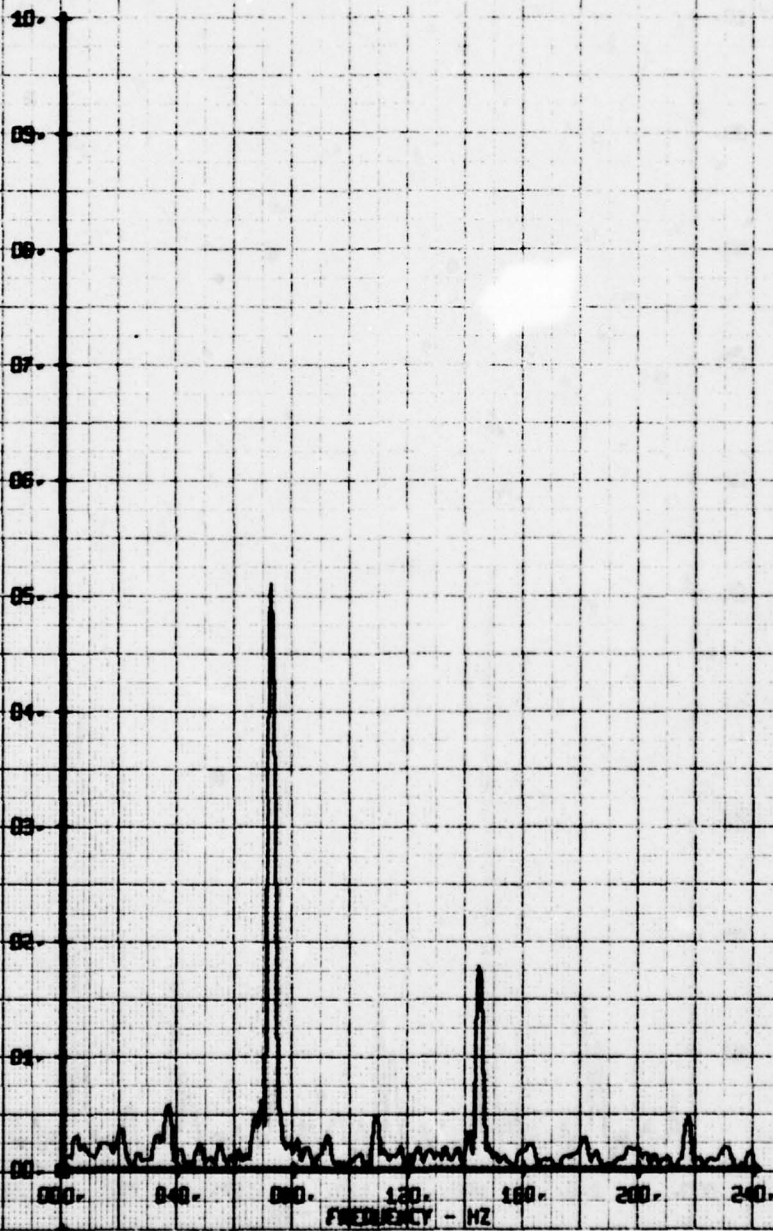
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP B

LEGEND
CH 66 PARAMETER
ALPHA

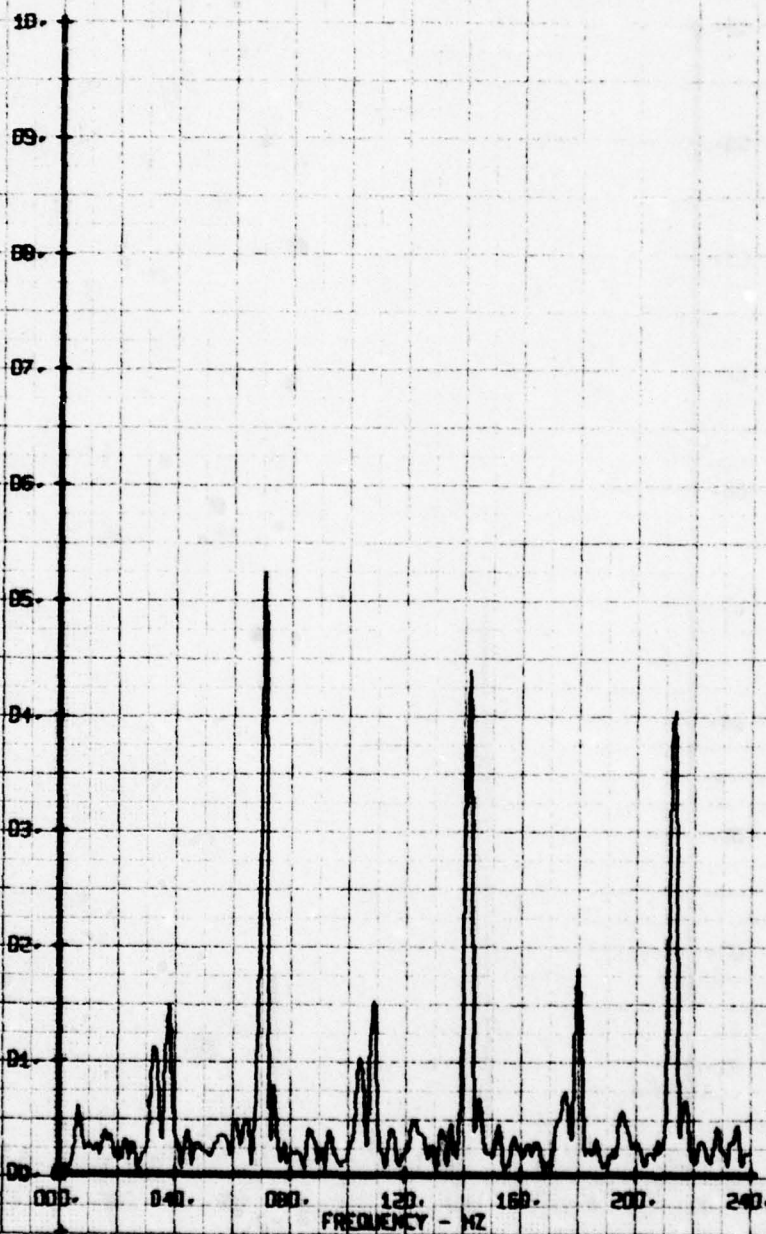
VERTICAL FLOW ANGLE, ALPHA - DEGREES



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60K1
RUN 150 TP 9

LEGEND
CH 66 PARAMETER
ALPHA

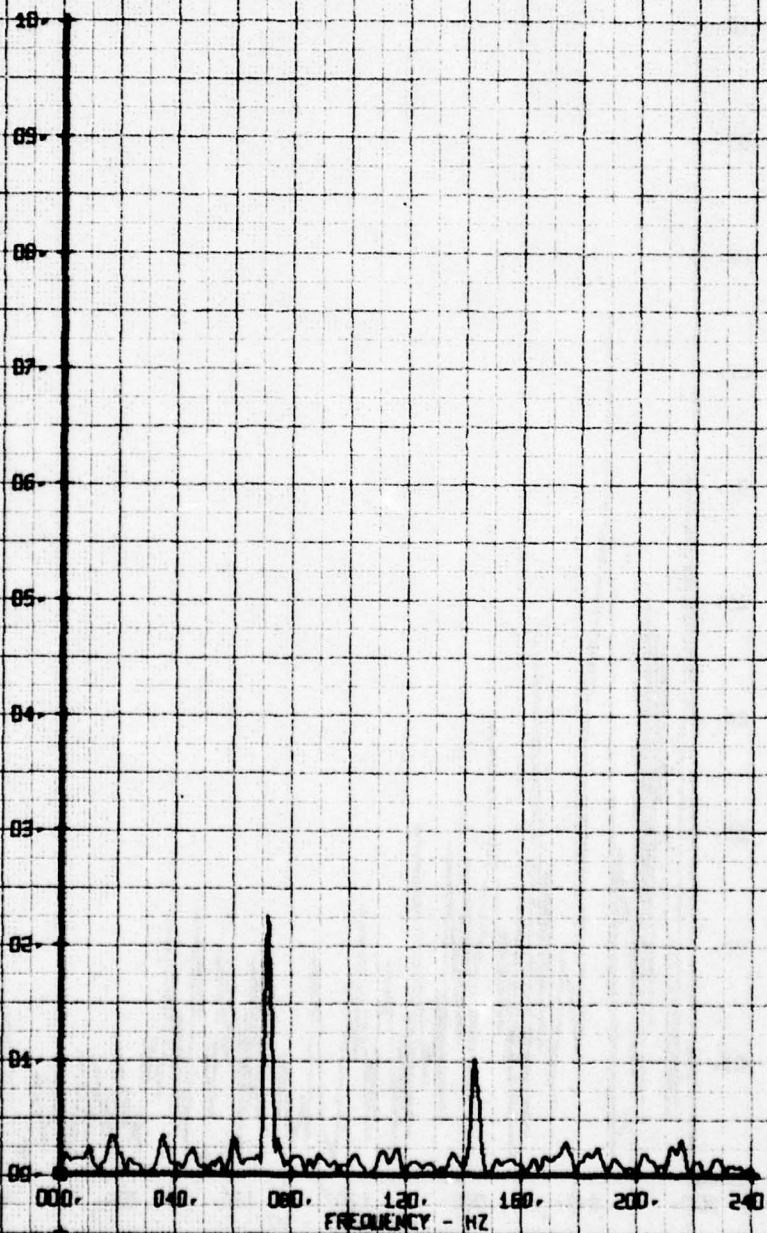
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WIRE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 10

LEGEND
CH 66
PARAMETER
ALPHA

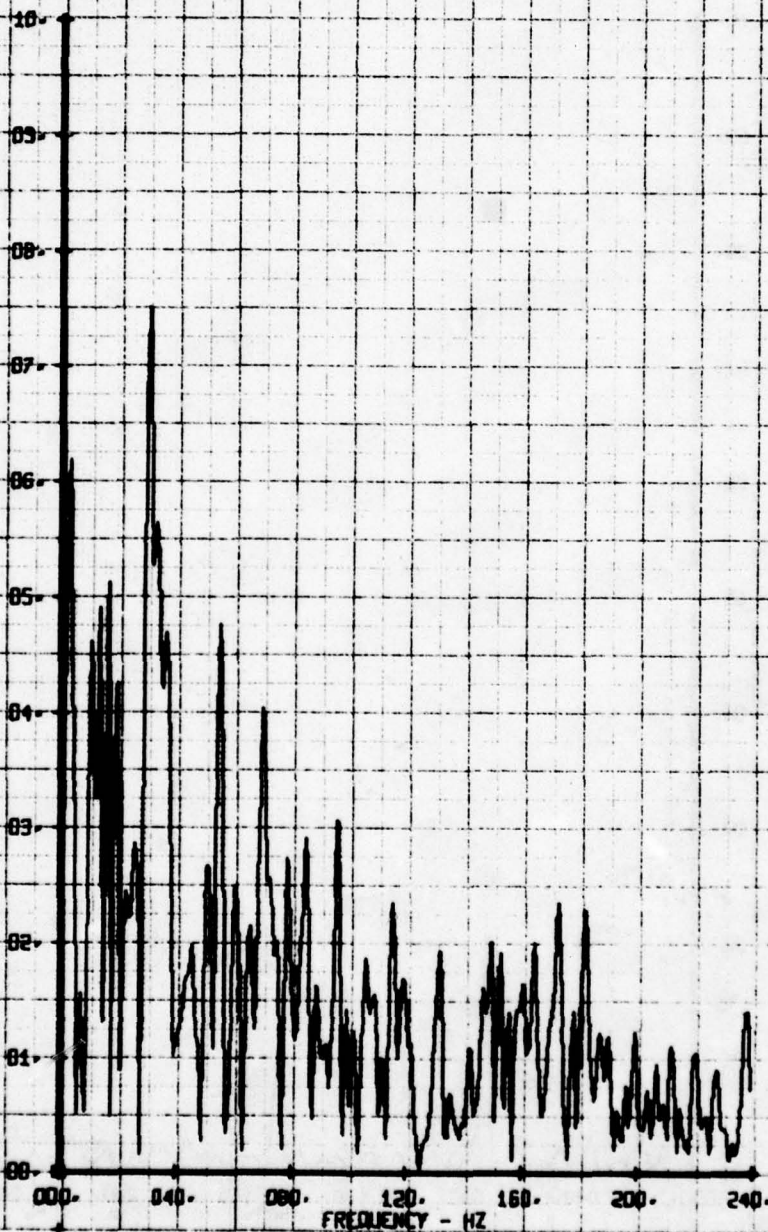
VERTICAL FLOW ANGLE, ALPHA - DEGREES



MIT FILM WAVE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 2

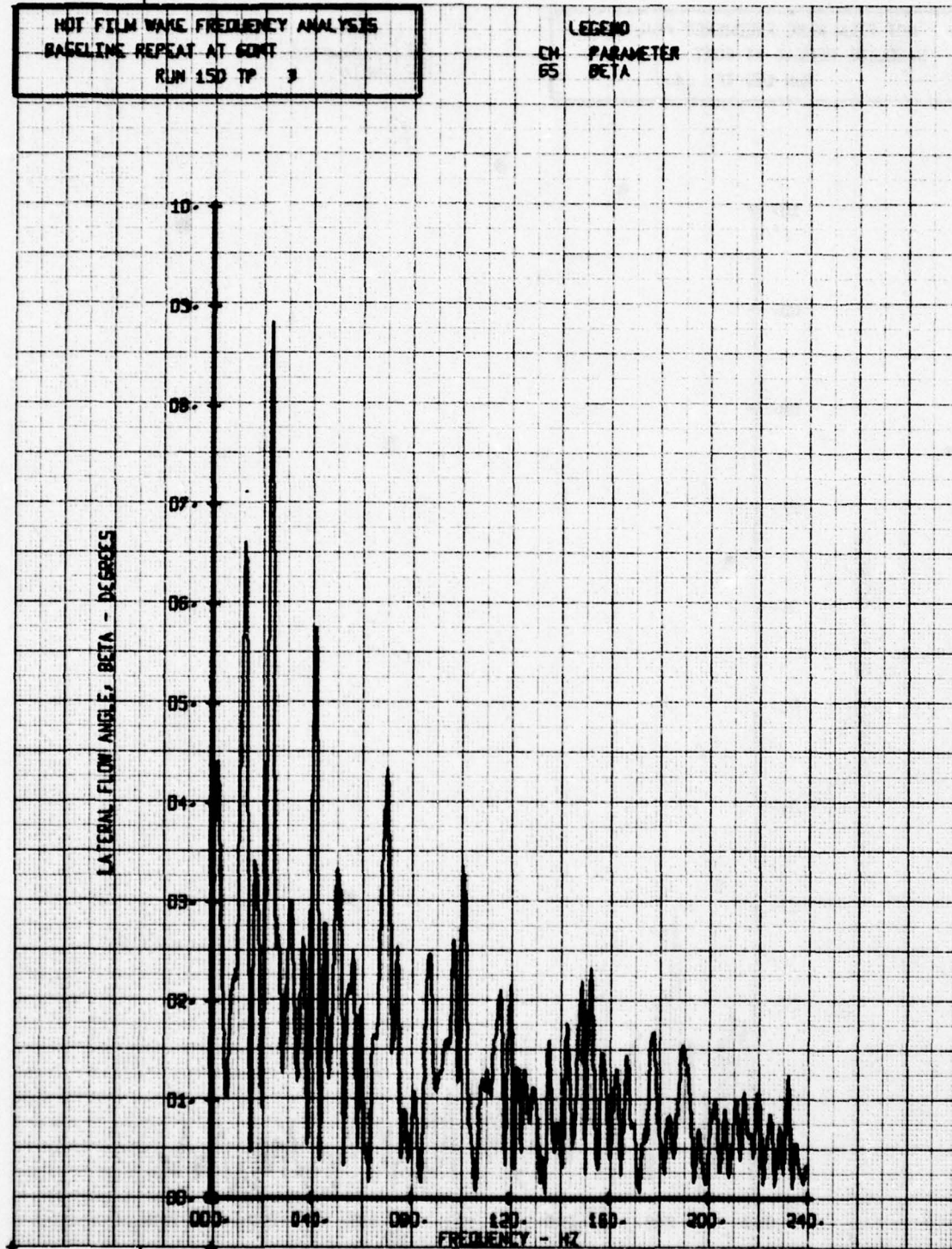
LEGEND
CN 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 3

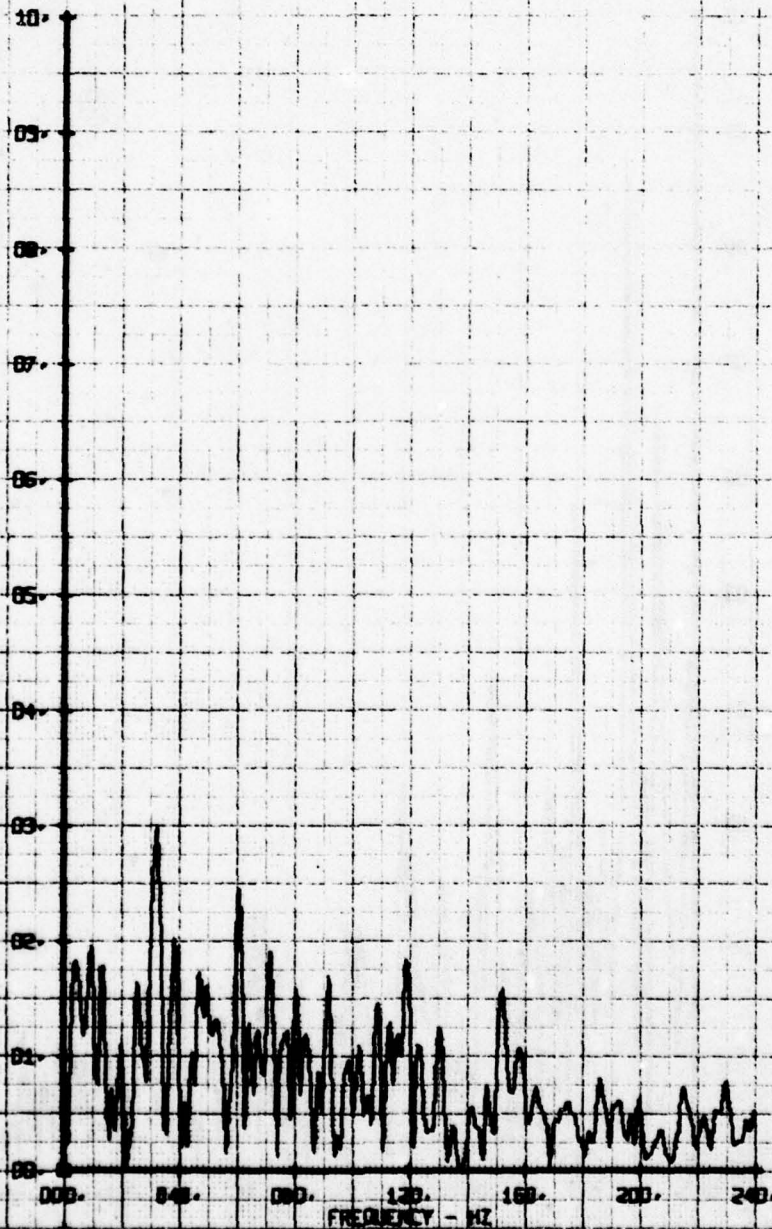
LEGEND
CH PARAMETER
BS BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 4

LEGEND
CH 65 PARAMETER
BEJA

LATERAL FLOW ANGLE, BEJA - DEGREES



HOT FILM WAVE FREQUENCY ANALYSIS

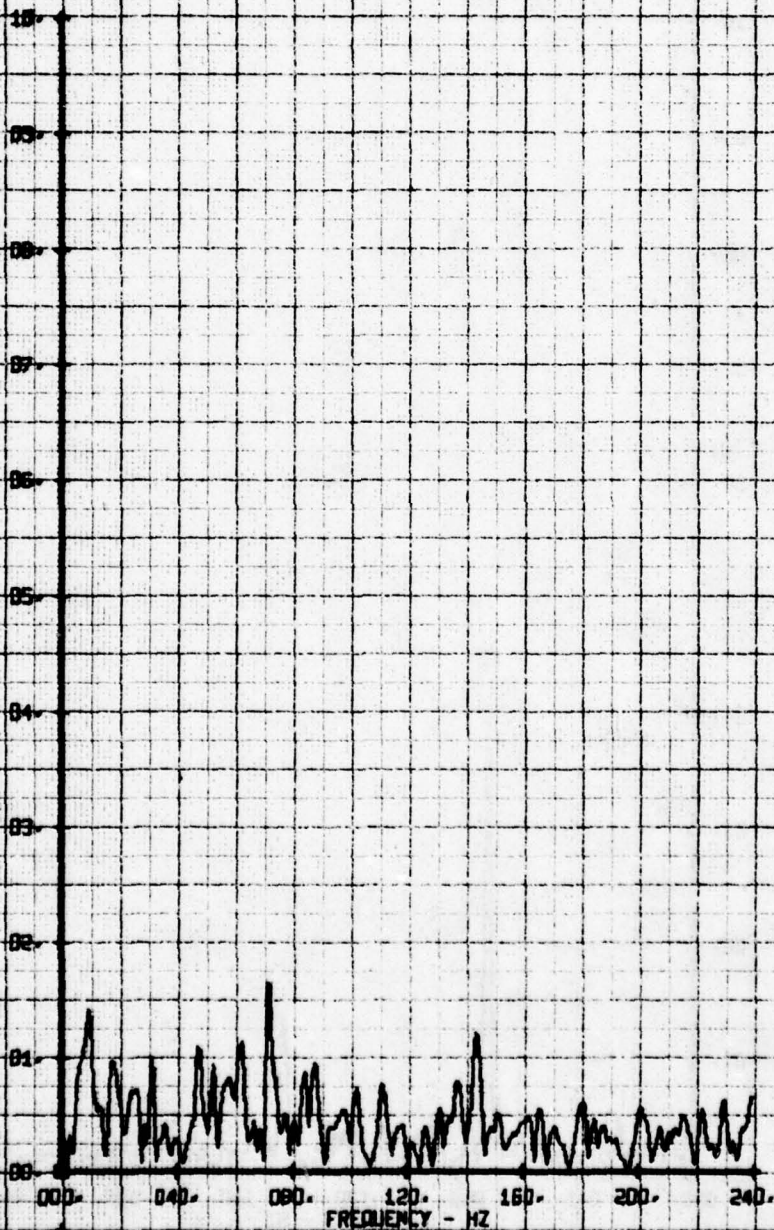
BASCELME REPEAT AT 60MT

RUN 150 TP S

LEGEND

CH PARAMETER
PS BETA

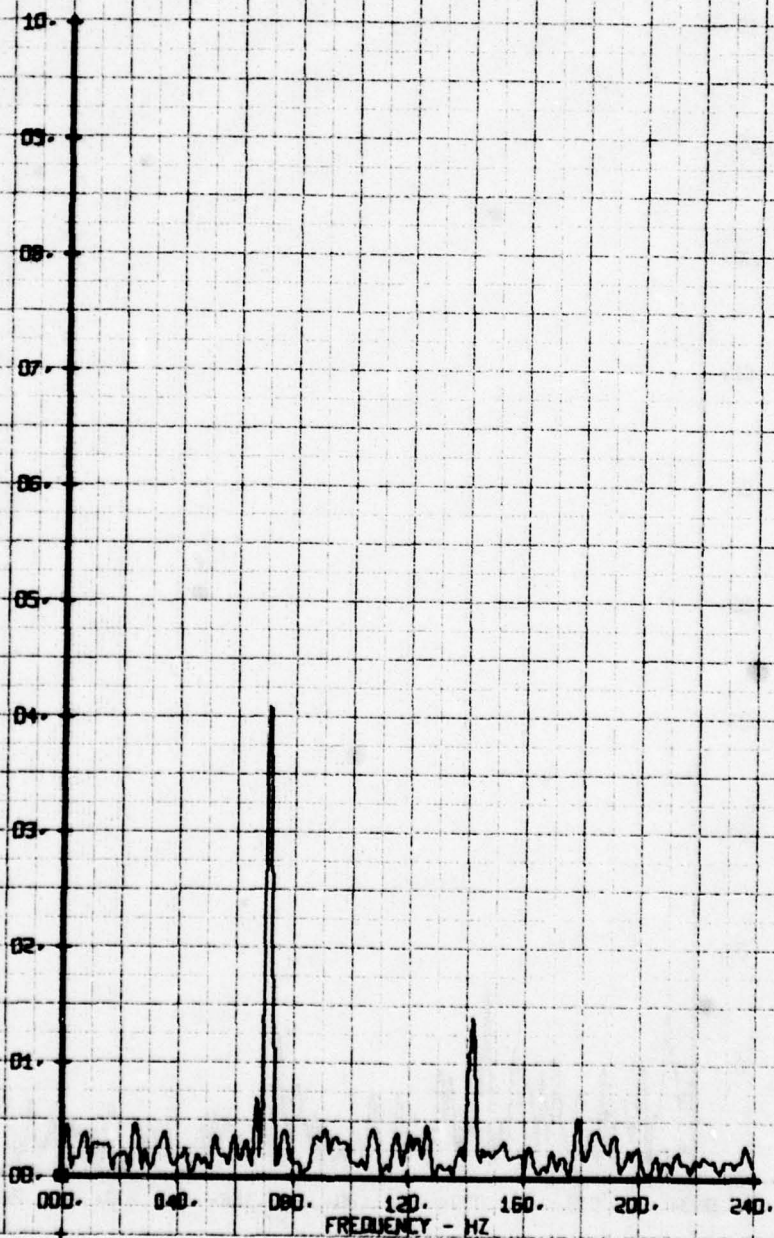
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 6

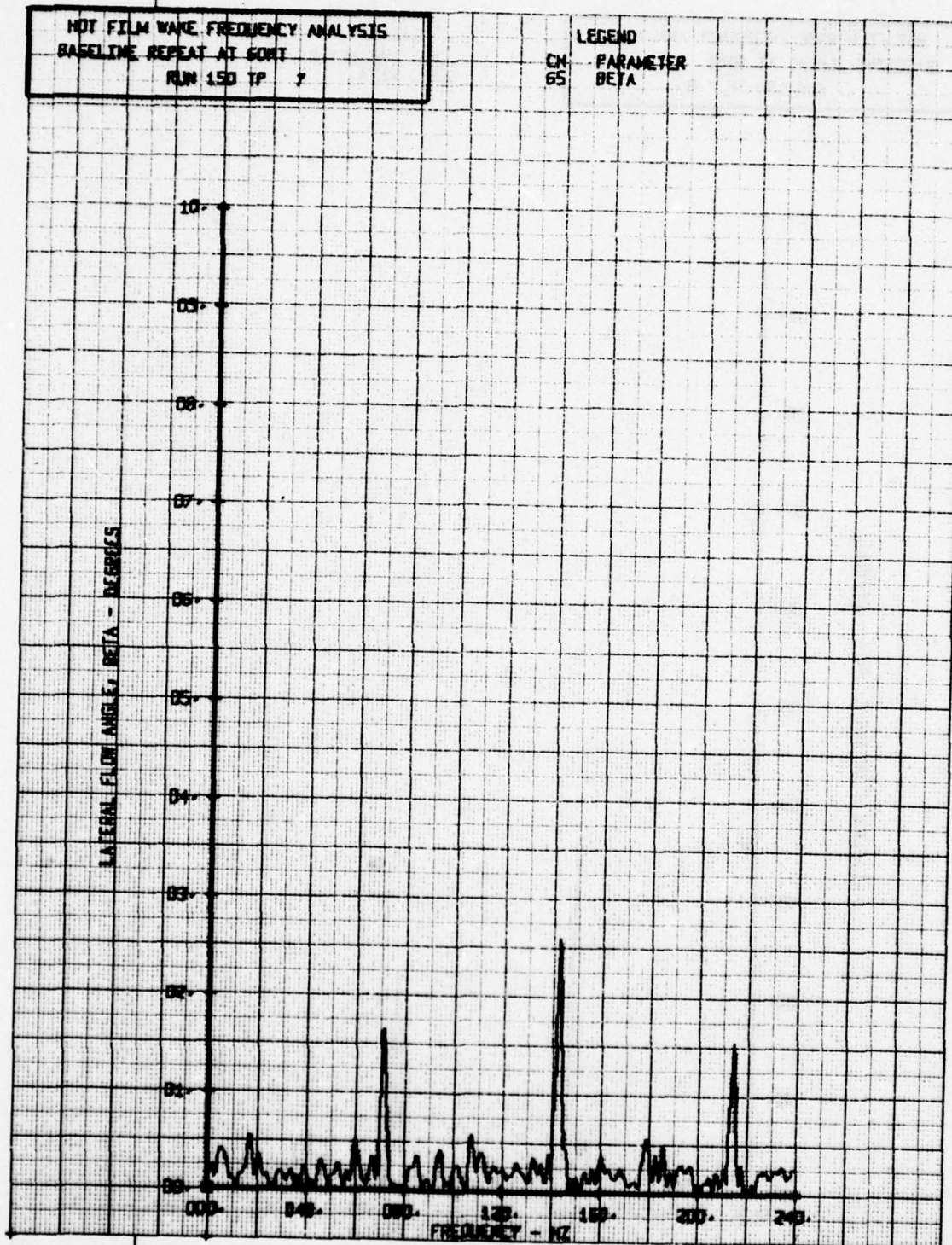
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60FT
RUN 150 TP 7

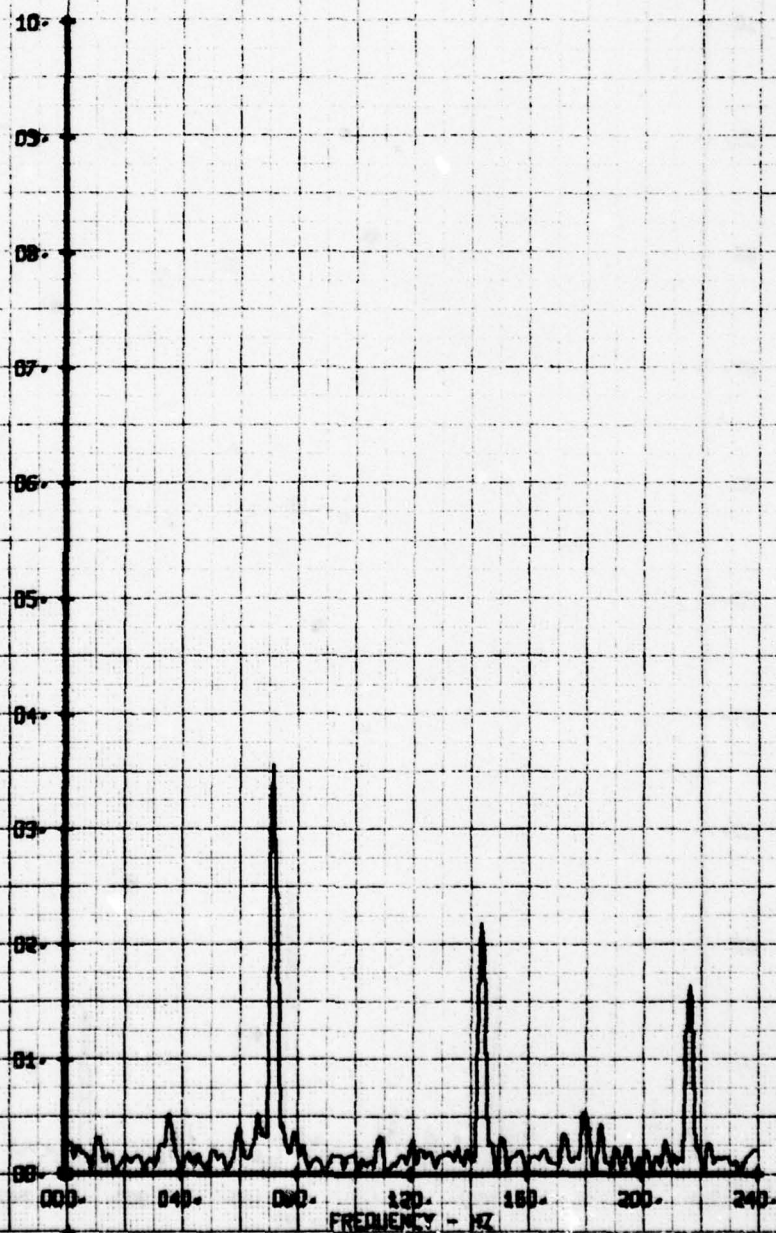
LEGEND
CN 65
PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 600T
RUN 150 TP B

LEGEND
CH: PARAMETER
BS: BETA

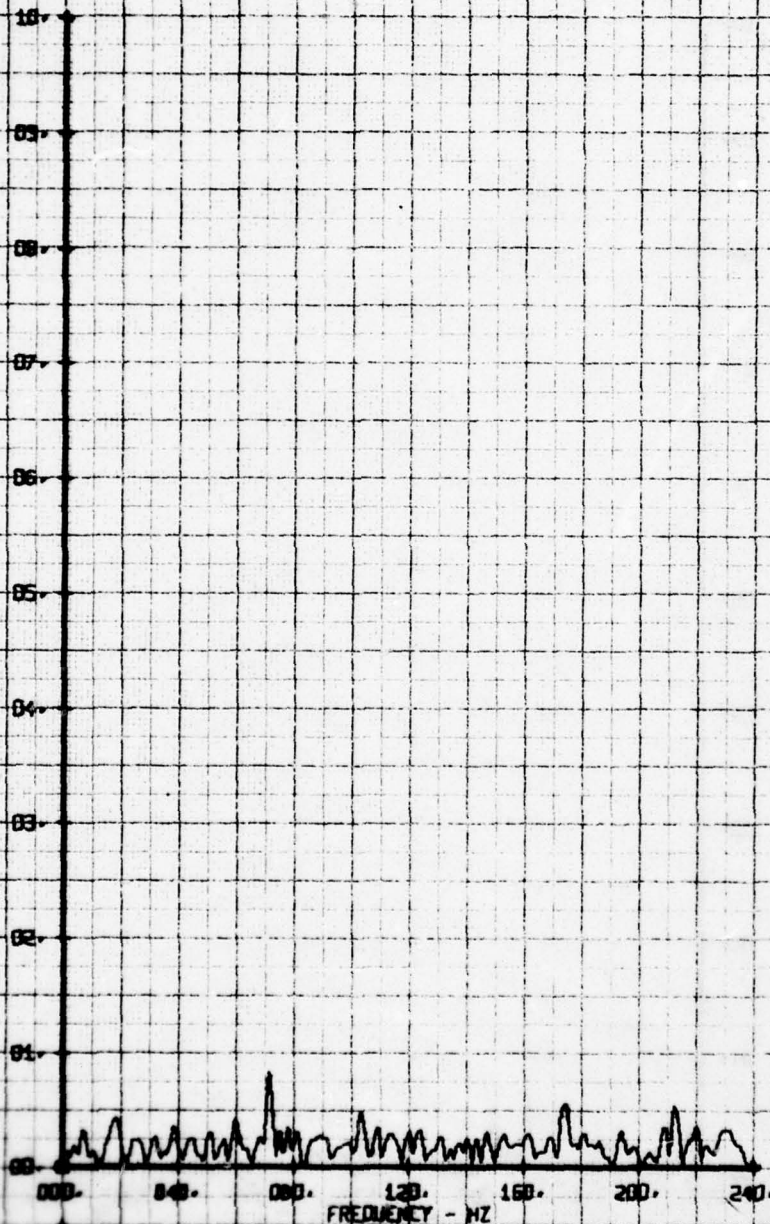
LATERAL FLOW ANGLE, BETA - DEGREES



NOT FILM WAVE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60HZ
RUN 150 TP 9

LEGEND
CH 65
PARAMETER
BETA

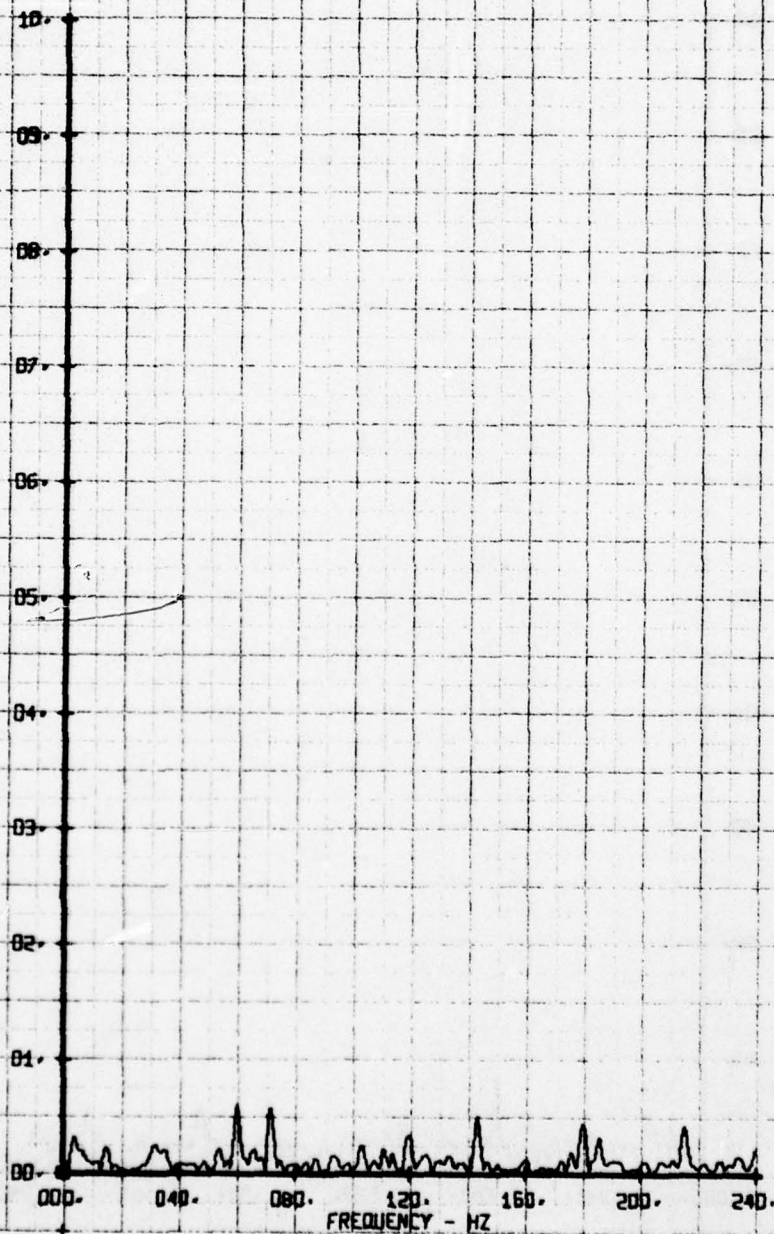
LATERAL FLOW ANGLE, BETA - DEGREES



NOT FILM WAVE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 10

LEGEND
CM PARAMETER
65 BETA

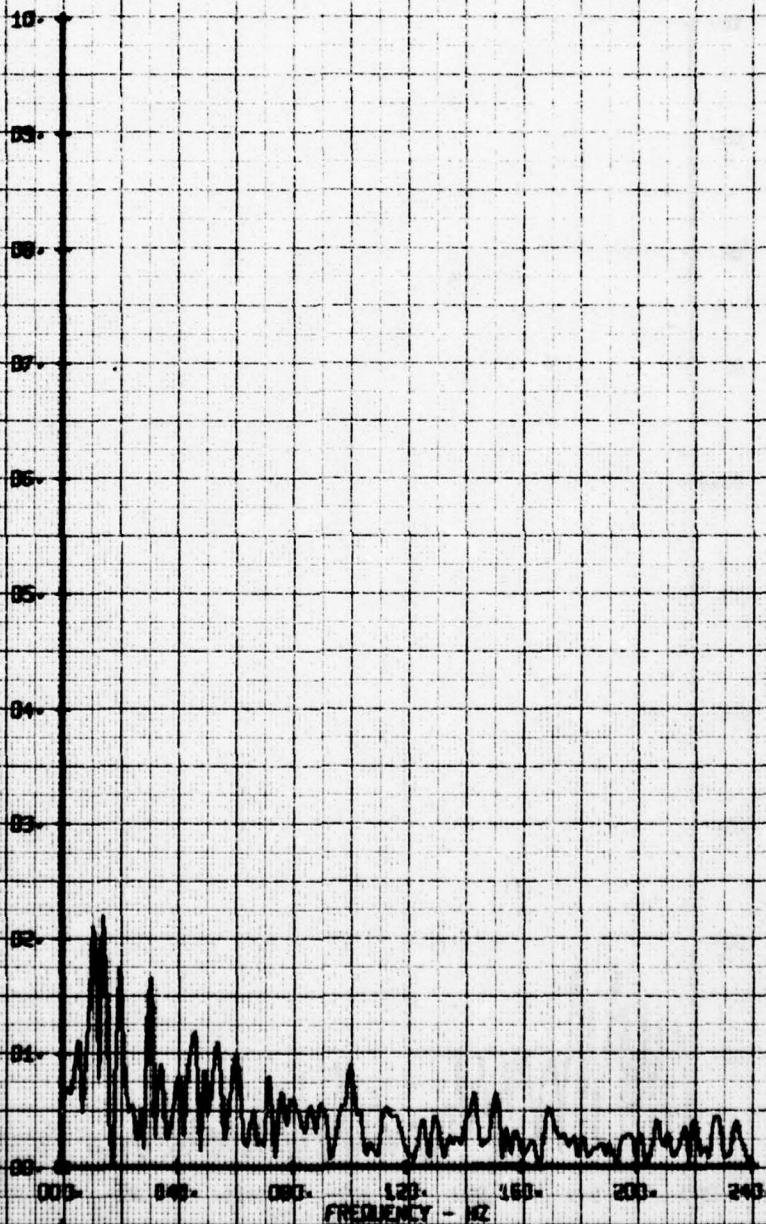
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60FT
RUN 150 TP 2

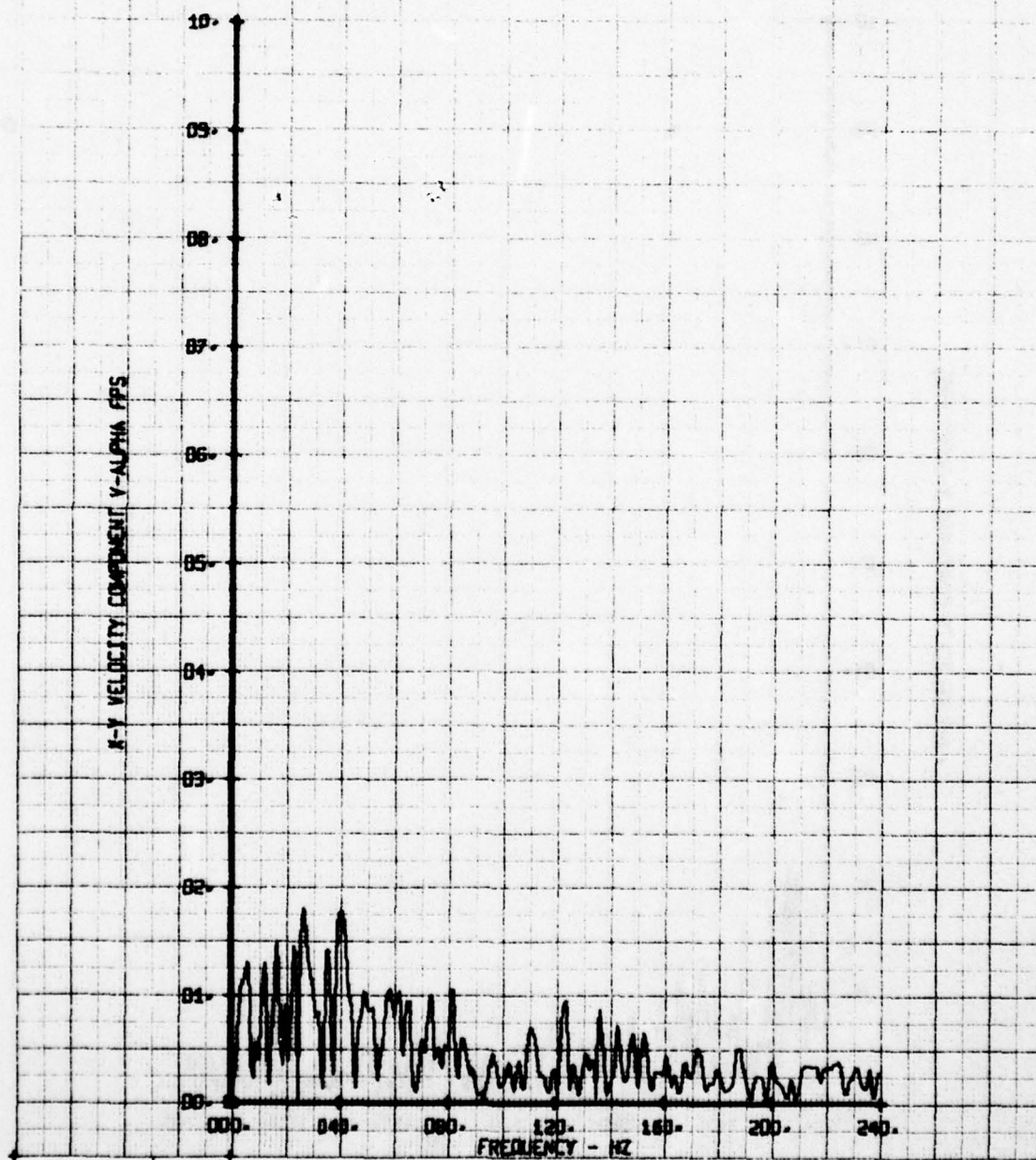
LEGEND
DN PARAMETER
66 V-ALPHA

V-1 VELOCITY COMPONENT V-ALPHA PPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 3

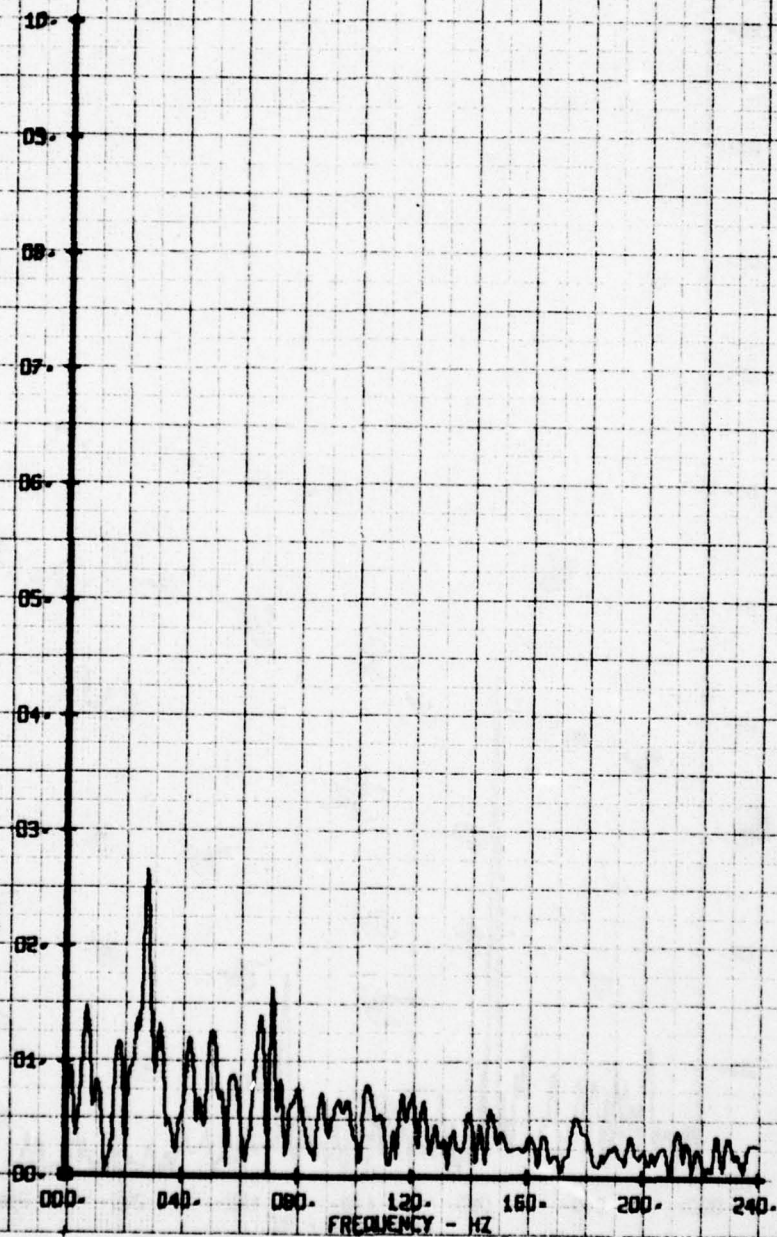
LEGEND
CH PARAMETER
66 V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 4

LEGEND
CH 66 PARAMETER
66 V-ALPHA

X-Y VELOCITY COMPONENT V-ALPHA FPS



HOT FILM WAVE FREQUENCY ANALYSIS

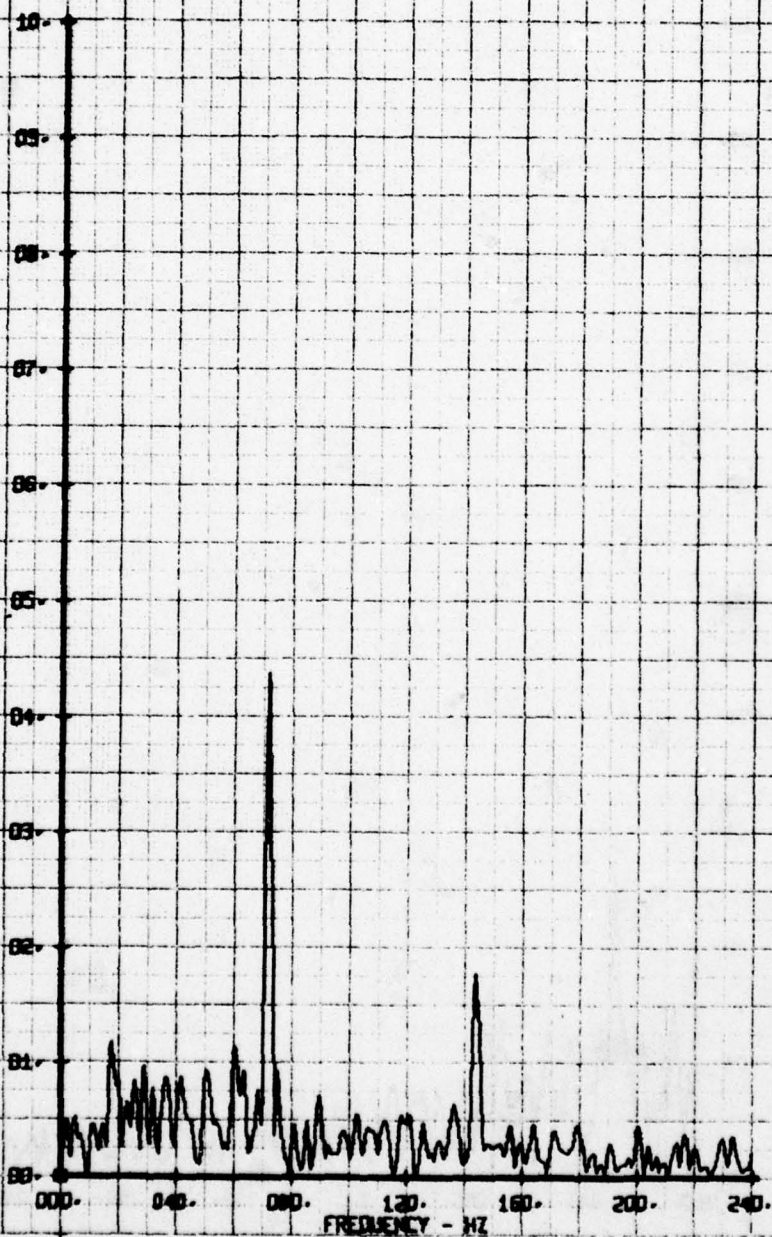
BASELINE REPEAT AT 60T

RUN 150 TP 5

LEGEND

| CH | PARAMETER |
|----|-----------|
| 56 | V-ALPHA |

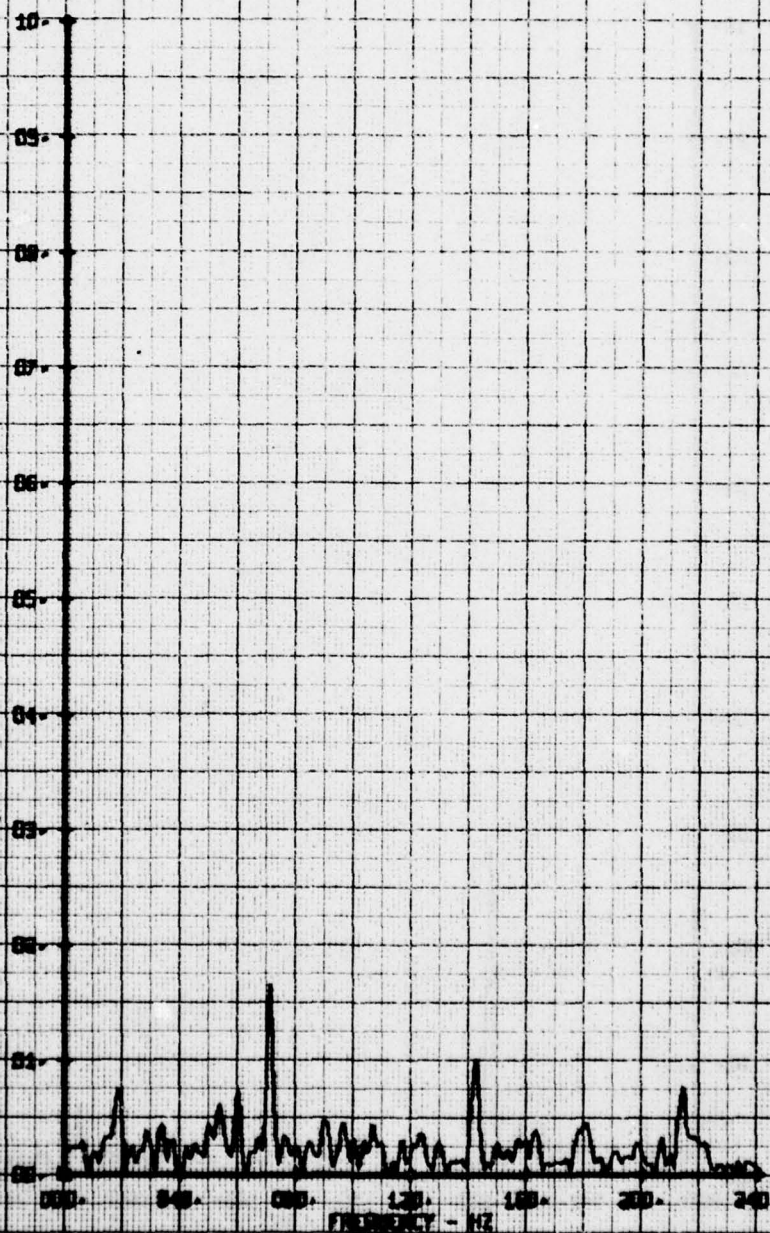
X-Y VELOCITY COMPONENT V-ALPHA FPS



NOT FILM WARE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60K1
RUN 150 TP 6

LEGEND
CH 66 PARAMETER
V-ALPHA

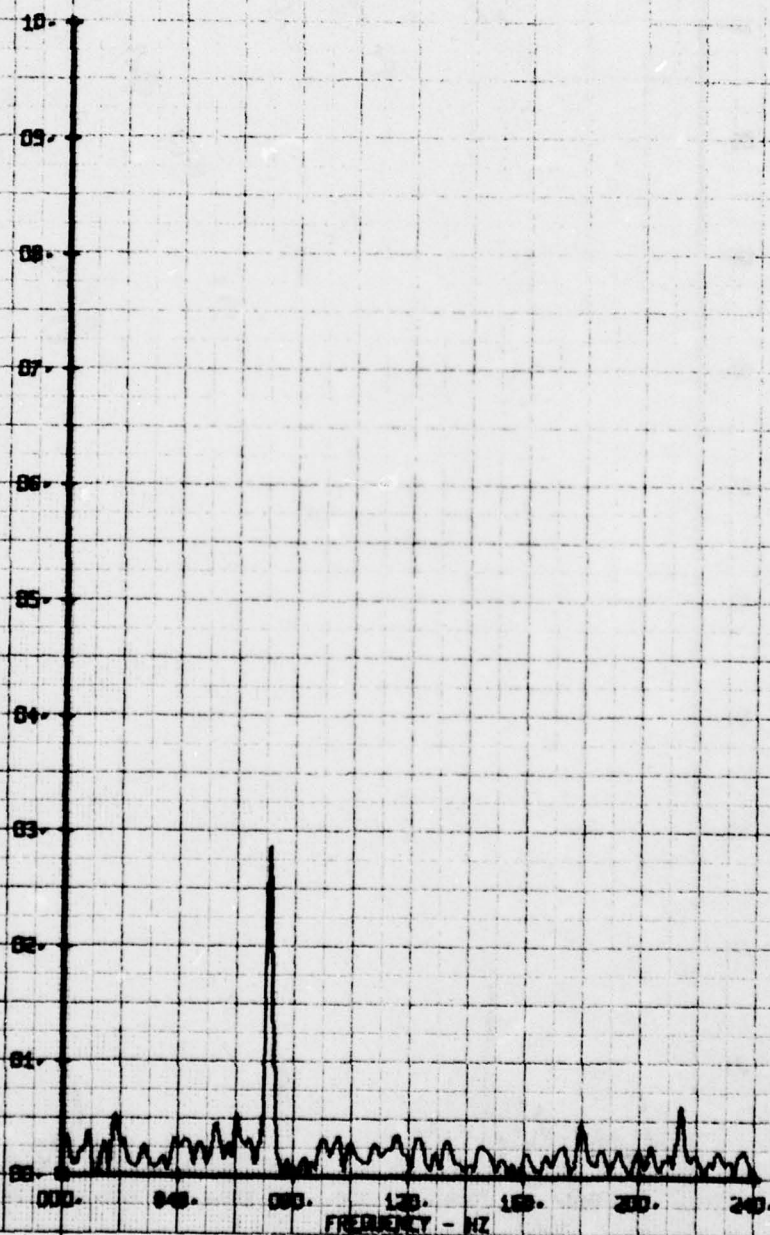
U-Y VELOCITY COMPONENT V-ALPHA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 7

LEGEND
CH. PARAMETER
66 V-ALPHA

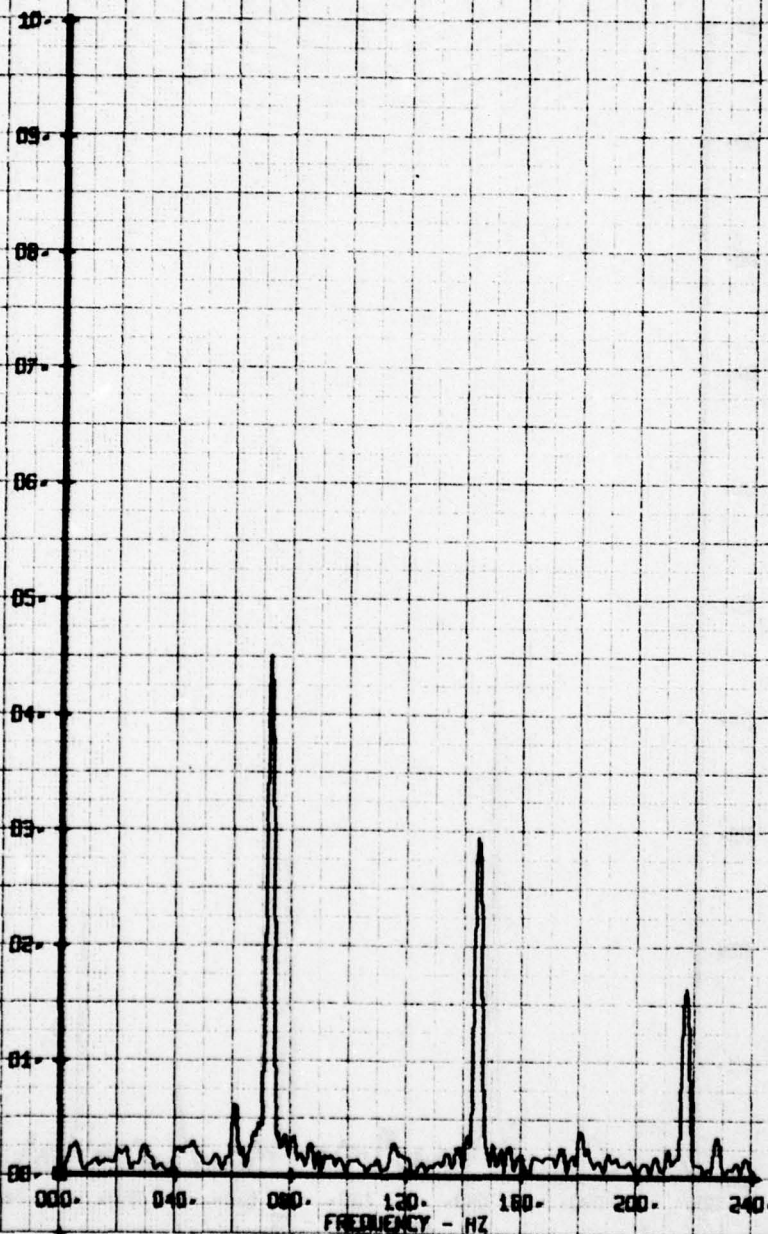
U-Y VELOCITY COMPONENT V-ALPHA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP B

LEGEND
CH PARAMETER
66 V-ALPHA

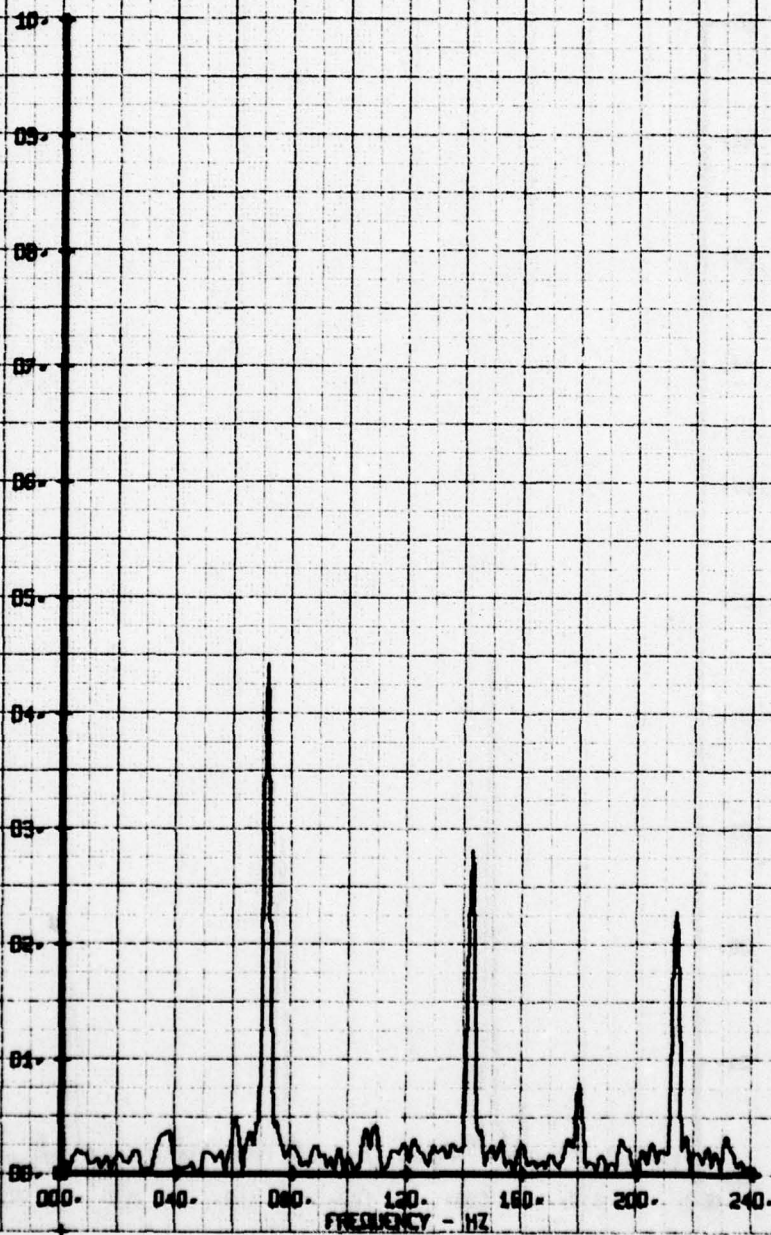
X-Y VELOCITY COMPONENT V-ALPHA FPS



HOT FILM WIRE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 3

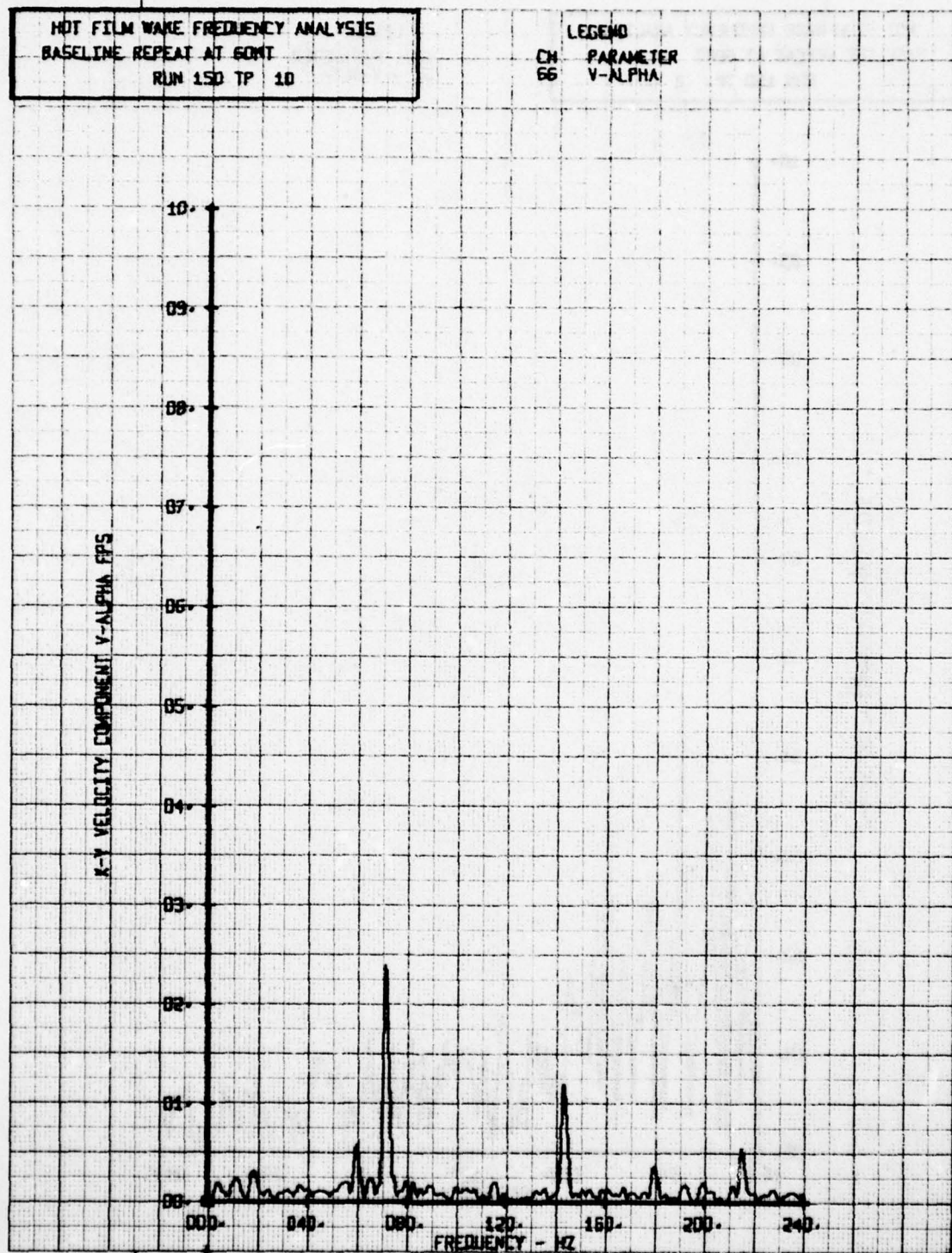
LEGEND
CH PARAMETER
66 V-ALPHA

V-ALPHA COMPONENT V-ALPHA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 10

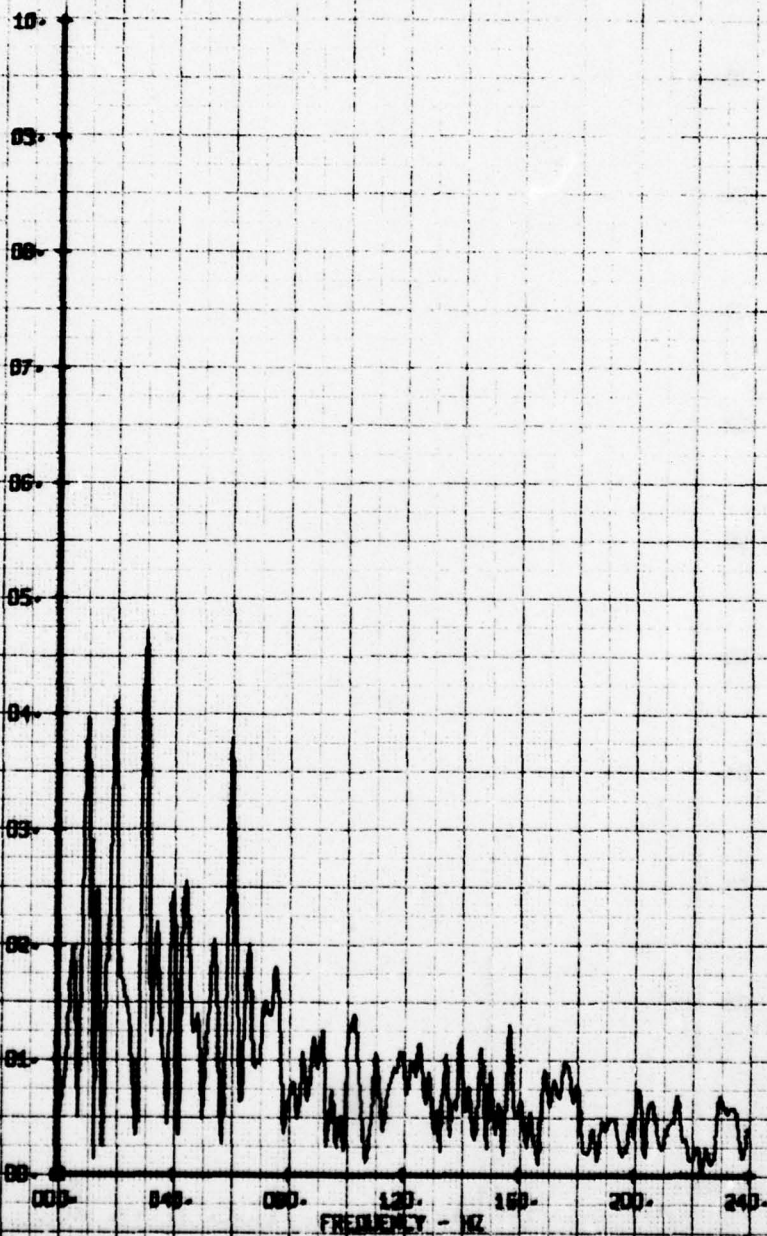
LEGEND
CH 66 PARAMETER
V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60MT
RUN 150 TP 2

LEGEND
CH 65 PARAMETER
V-BETA

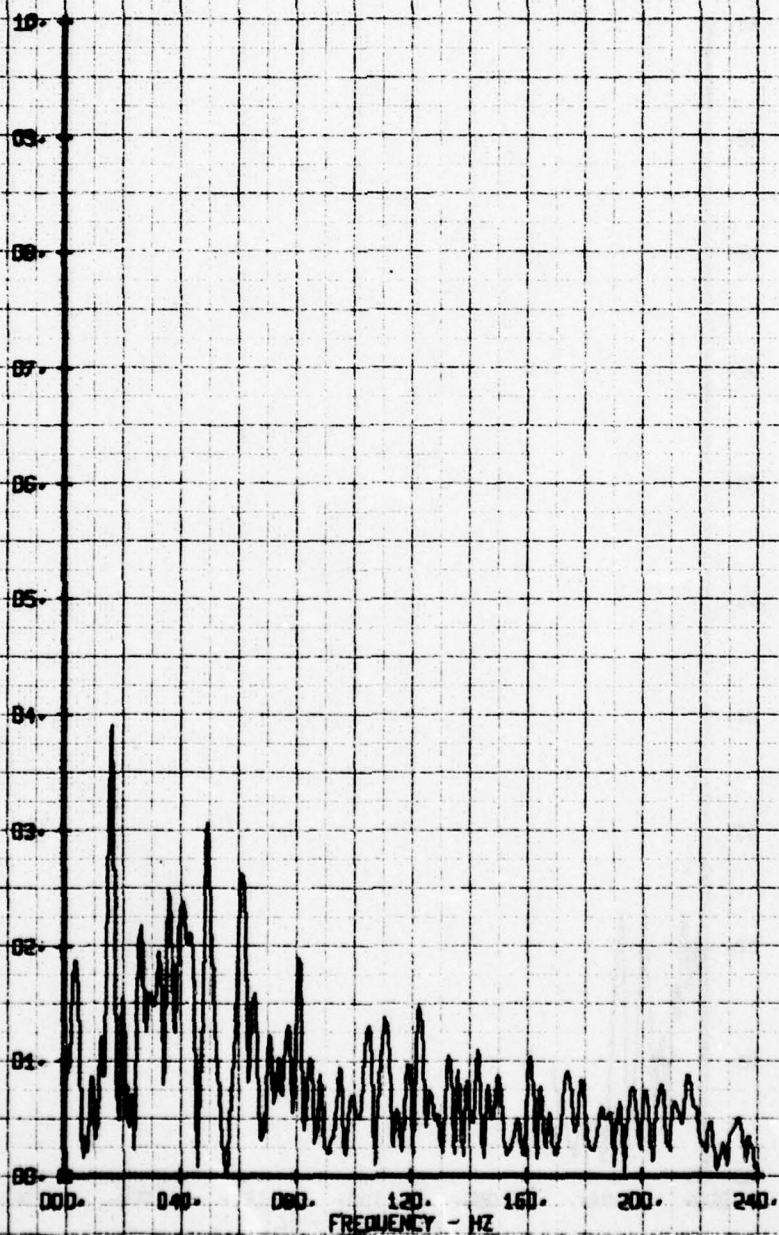
A-2 VELOCITY COMPONENT Y-BETA FFS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 3

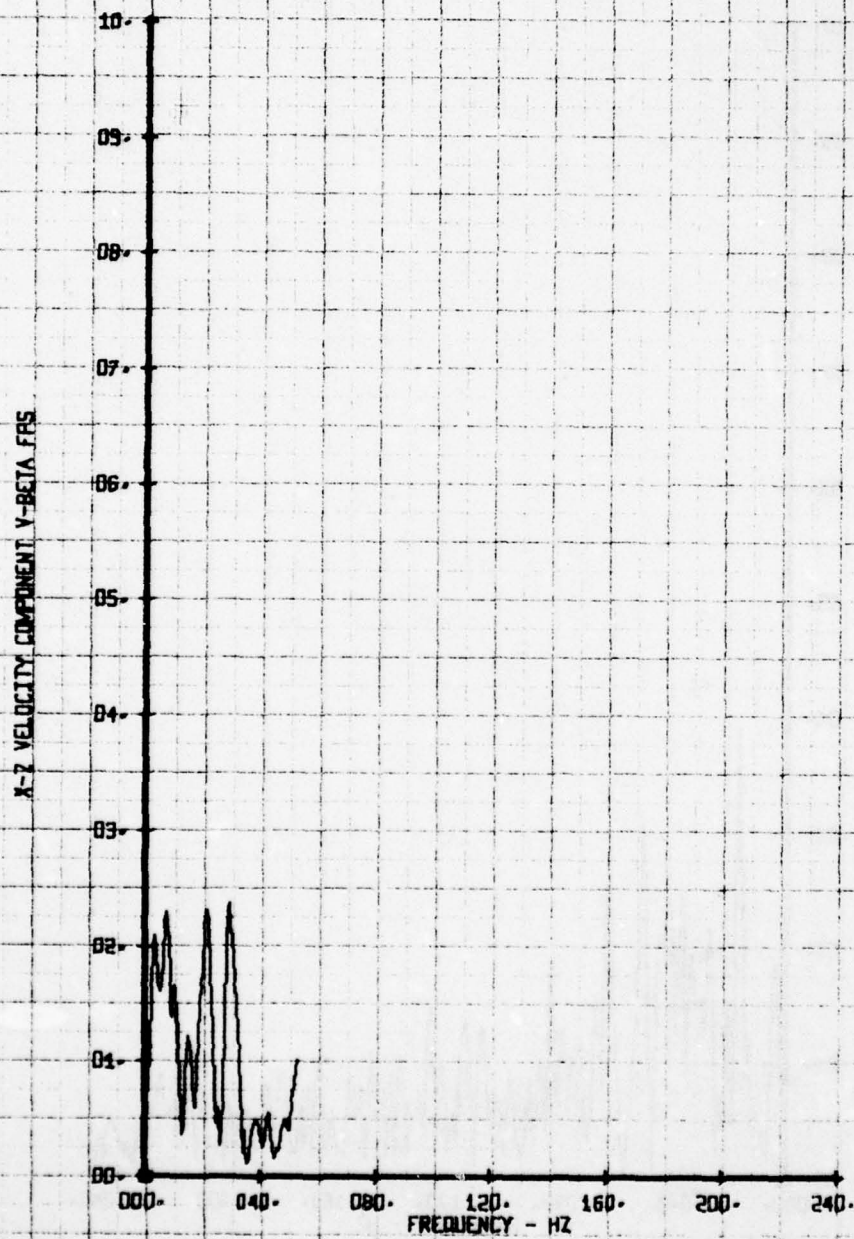
LEGEND
652 PARAMETER
V-BETA

X-2 VELOCITY COMPONENT V-BETA RMS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 4

LEGEND
CH 65 PARAMETER
Y-BETA



AD-A062 639

BOEING VERTOL CO PHILADELPHIA PA
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFI--ETC(U)
SEP 78 P F SHERIDAN

F/G 1/3

DAAJ02-77-C-0020

UNCLASSIFIED

USARTL-TR-78-236-V-7A

NL

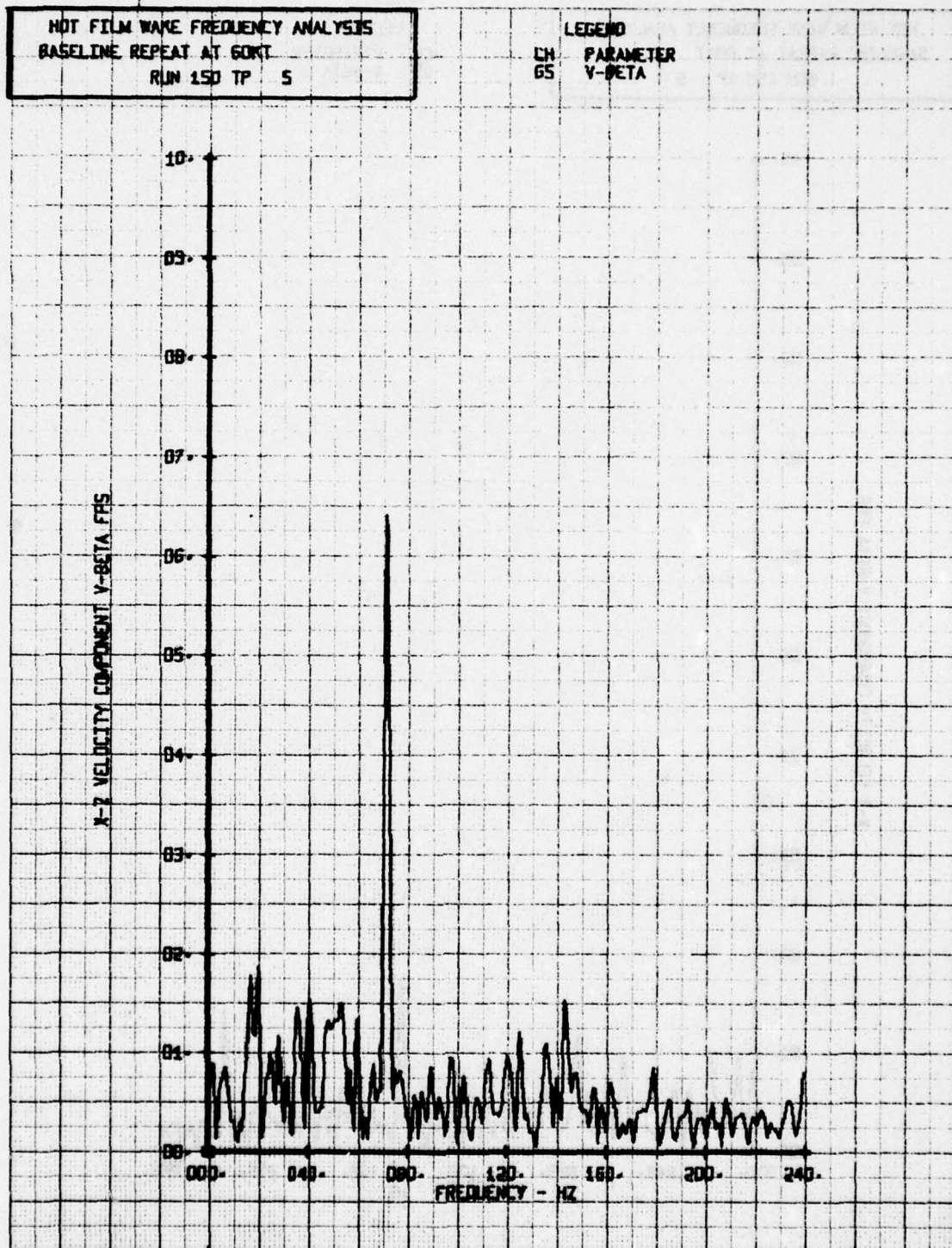
2 OF 3
ADA
062639

SEP 78



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 5

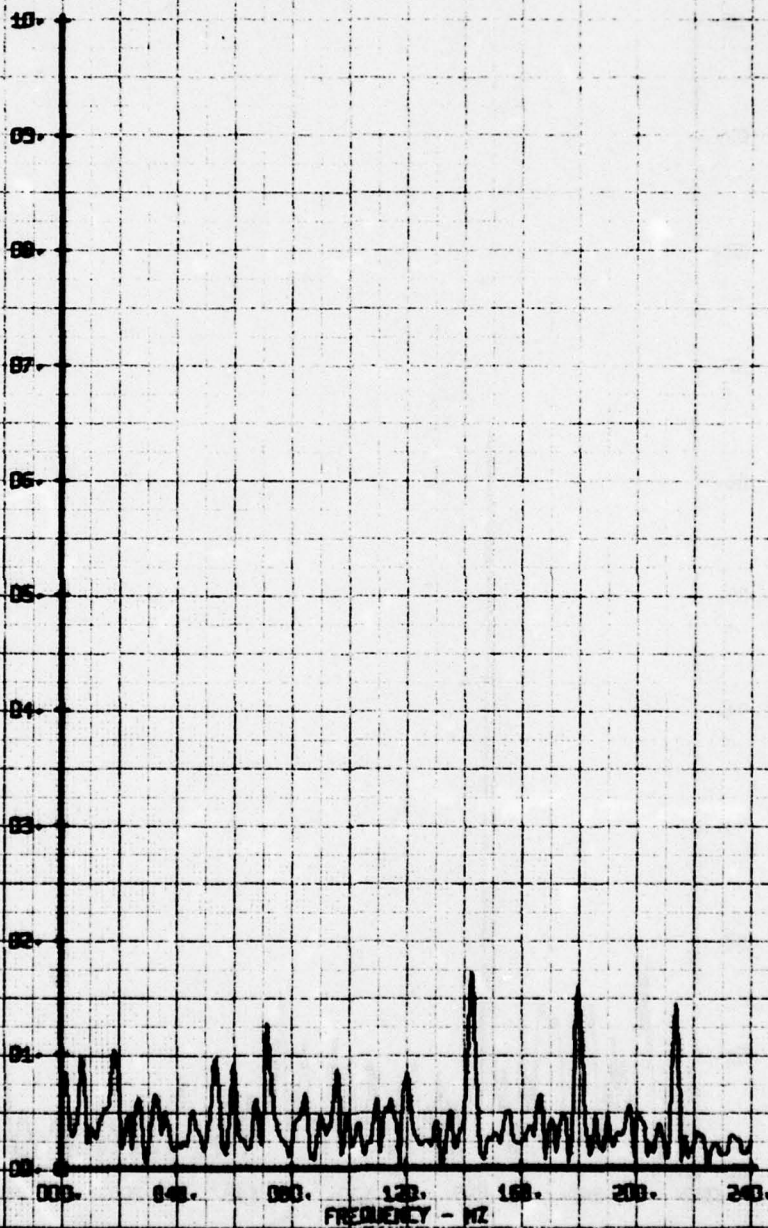
LEGEND
CH 65 PARAMETER
V-BETA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60RT
RUN 150 TP 6

LEGEND
CH 65 PARAMETER
V-BETA

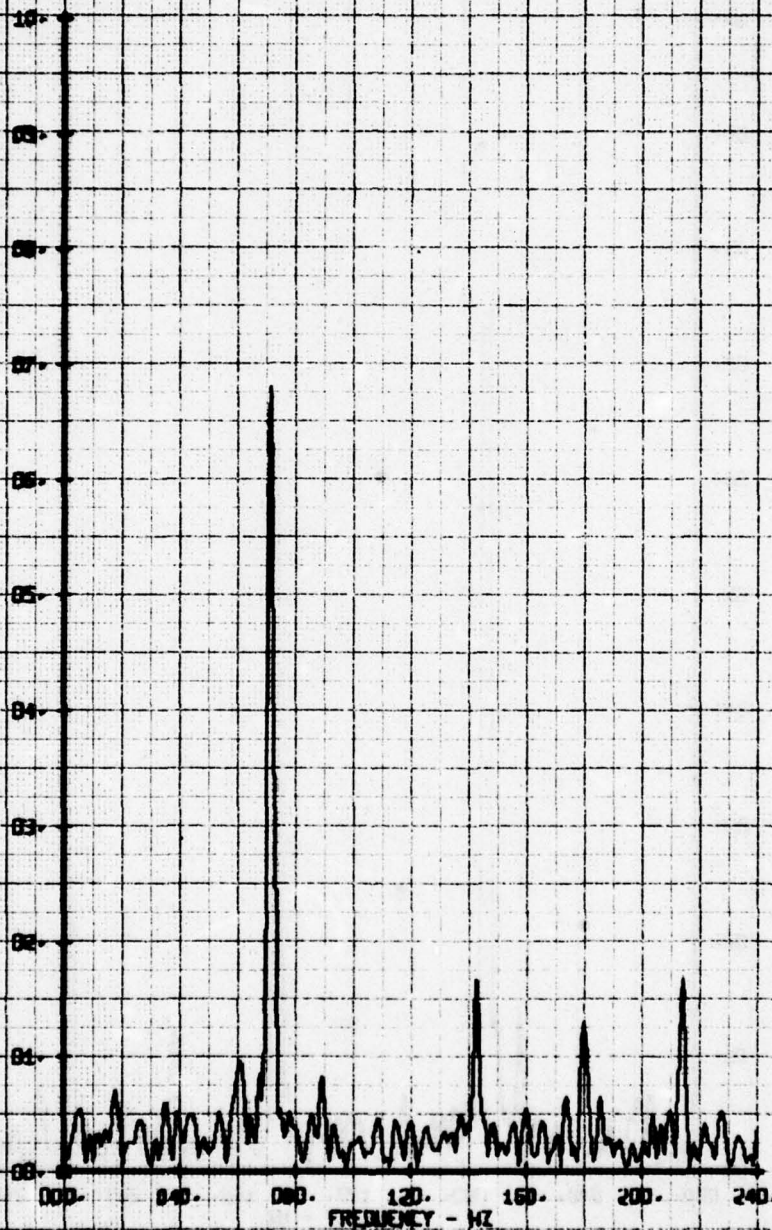
X-2 VELOCITY COMPONENT V-BETA FPS



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE REPEAT AT 500T
RUN 150 TP 7

LEGEND
CH PARAMETER
65 V-BETA

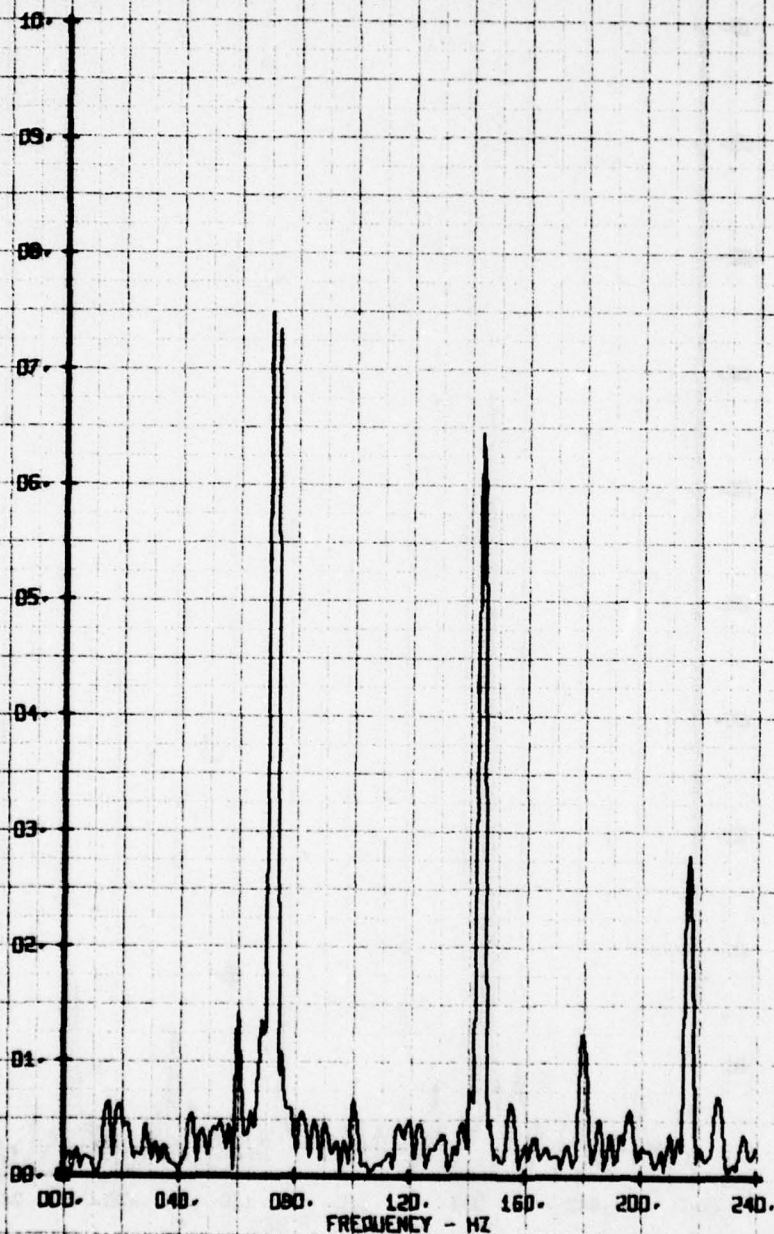
X-2 VELOCITY COMPONENT V-BETA FFS



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT CONT
RUN 150 TP 8

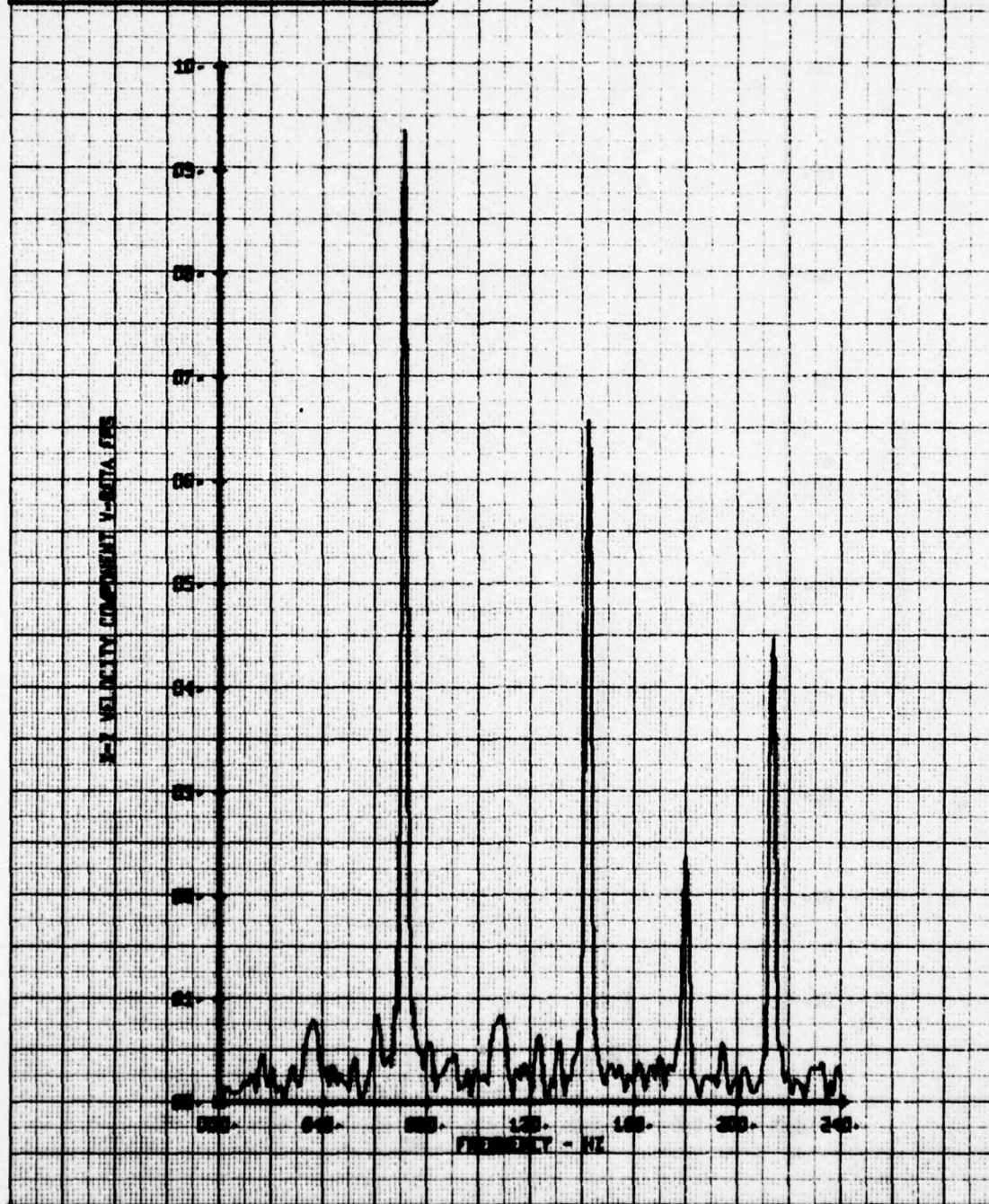
LEGEND
CH PARAMETER
65 V-BETA

X-Z VELOCITY COMPONENT V-BETA FHS



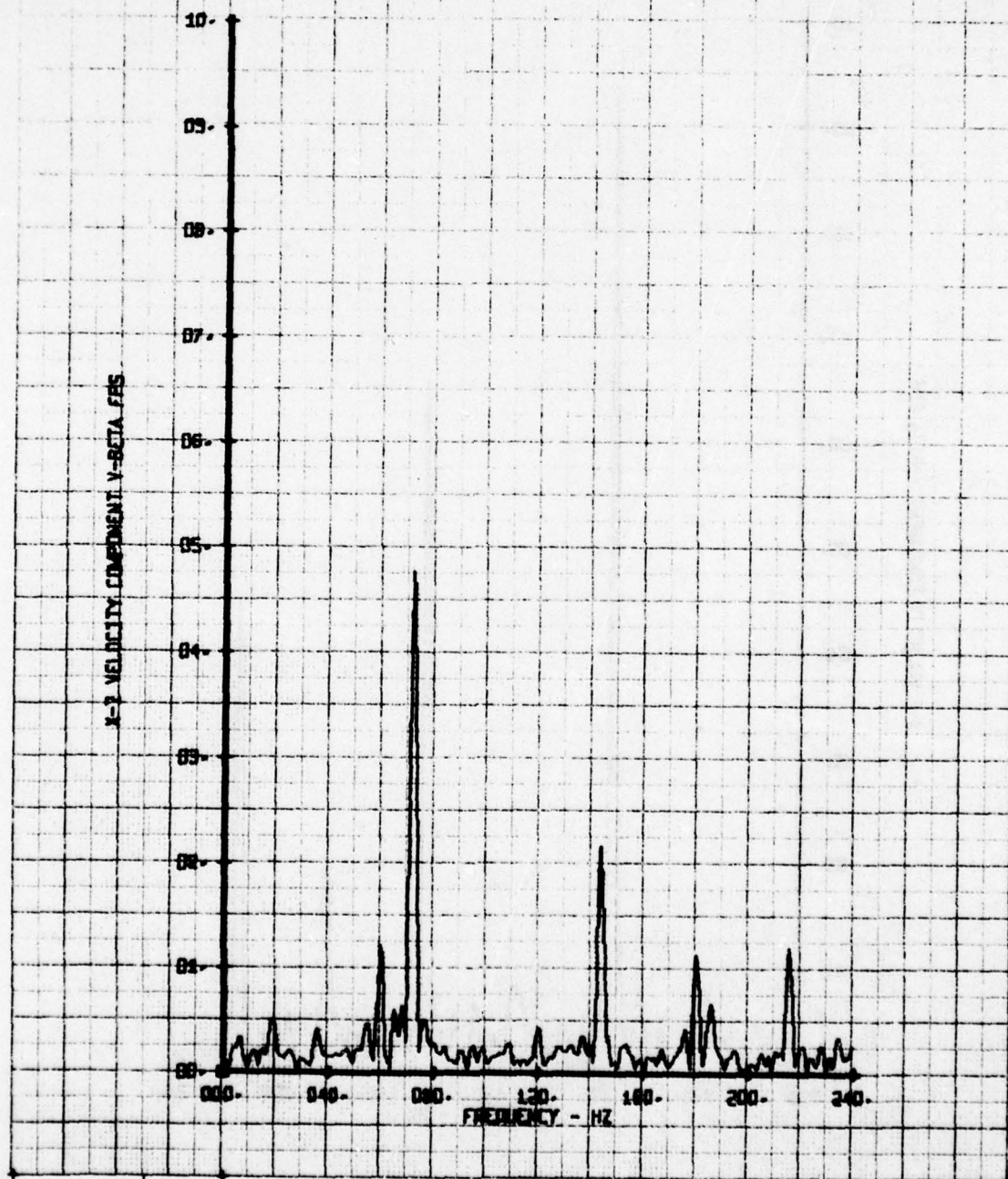
HIT FILM WAVE FREQUENCY ANALYSIS
 BASELINE REPEAT AT 50FT
 RUN 150 TP 3

LEGEND
 CH- PARAMETER
 65 V-BETA



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE REPEAT AT 60HT
RUN 150 TP 10

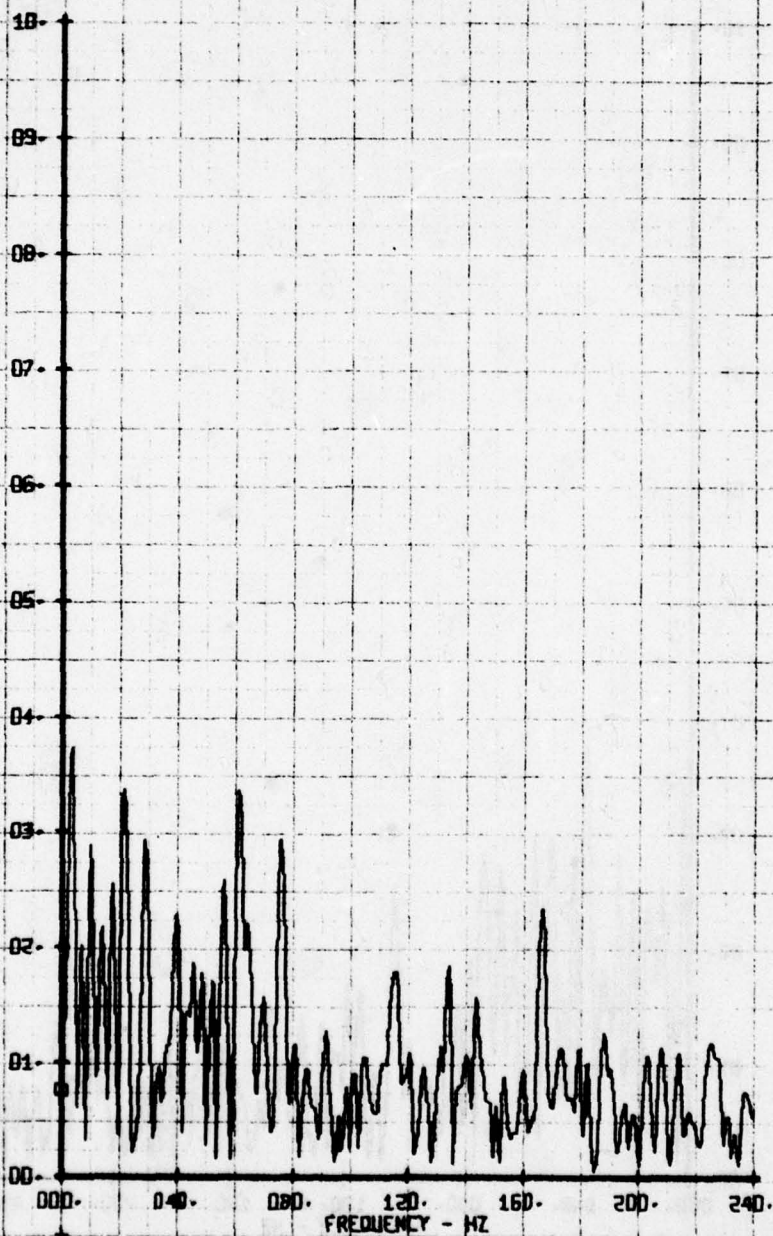
LEGEND
CH: PARAMETER
65: V-BETA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 5

LEGEND
CH 66
PARAMETER
ALPHA

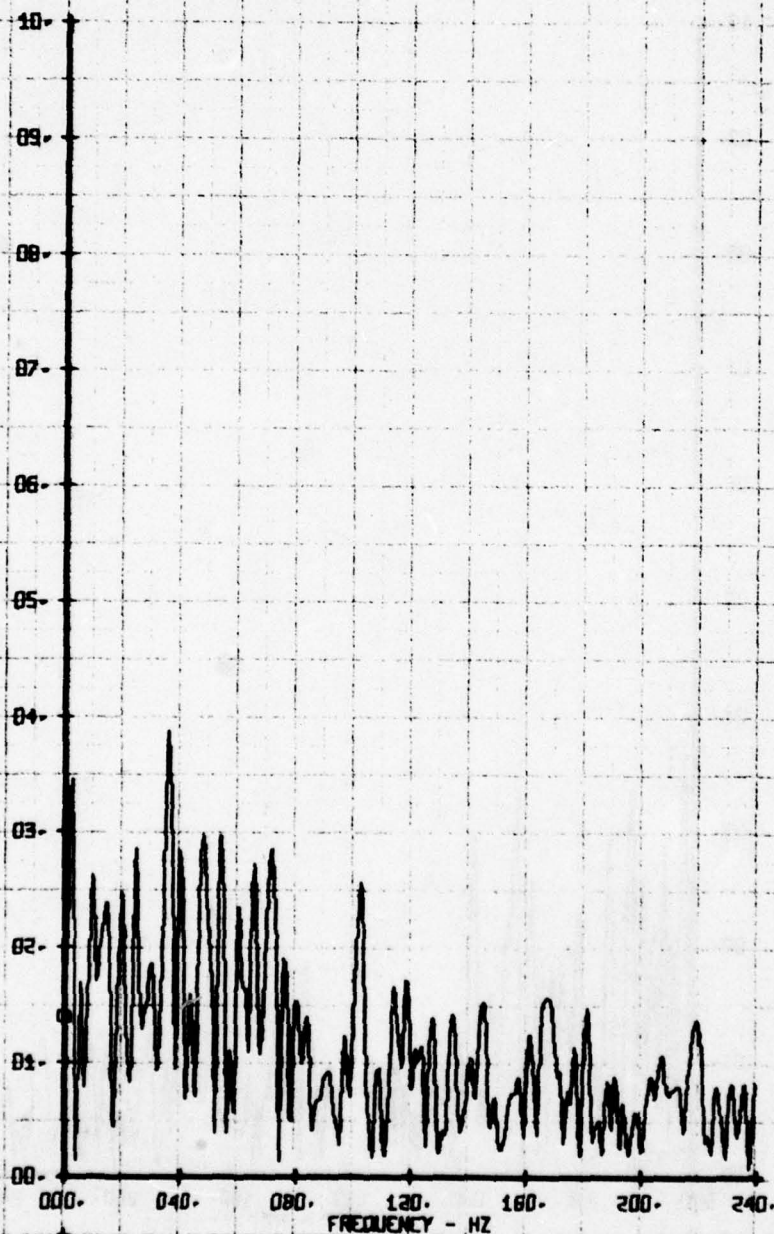
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, ROT. HUB
RUN 180 TP 6

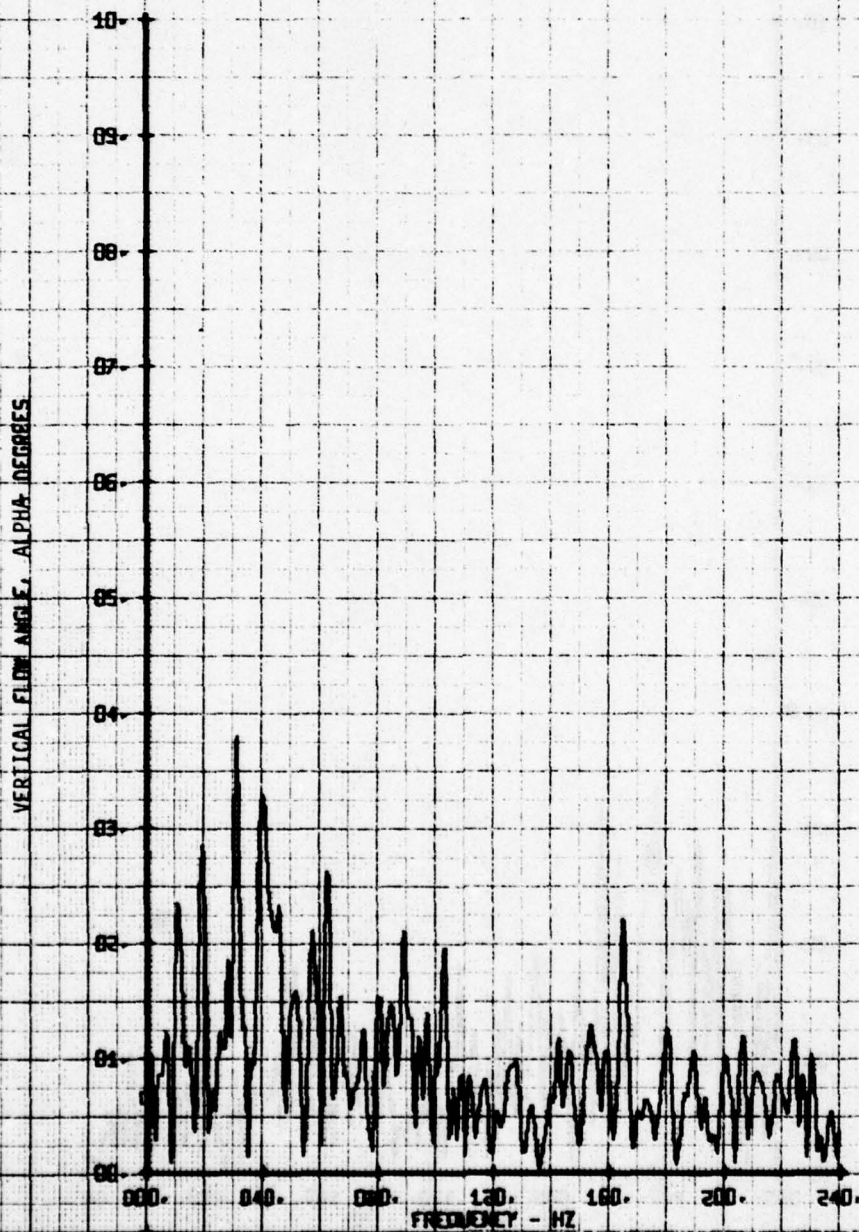
LEGEND
CH 66 PARAMETER
66 ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



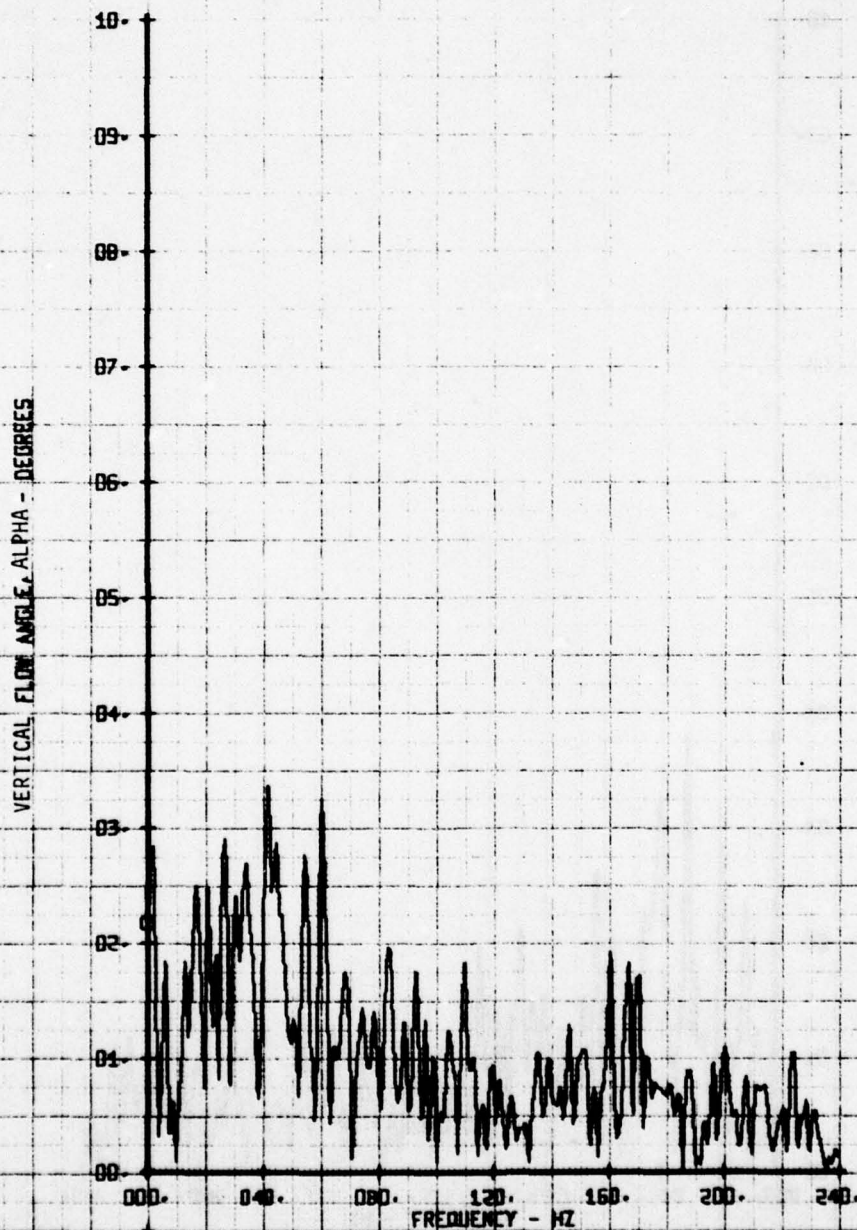
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 150 TP 7

LEGEND
CH. 66 PARAMETER
66 ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, RQT-HUB
RUN 160 TP 8

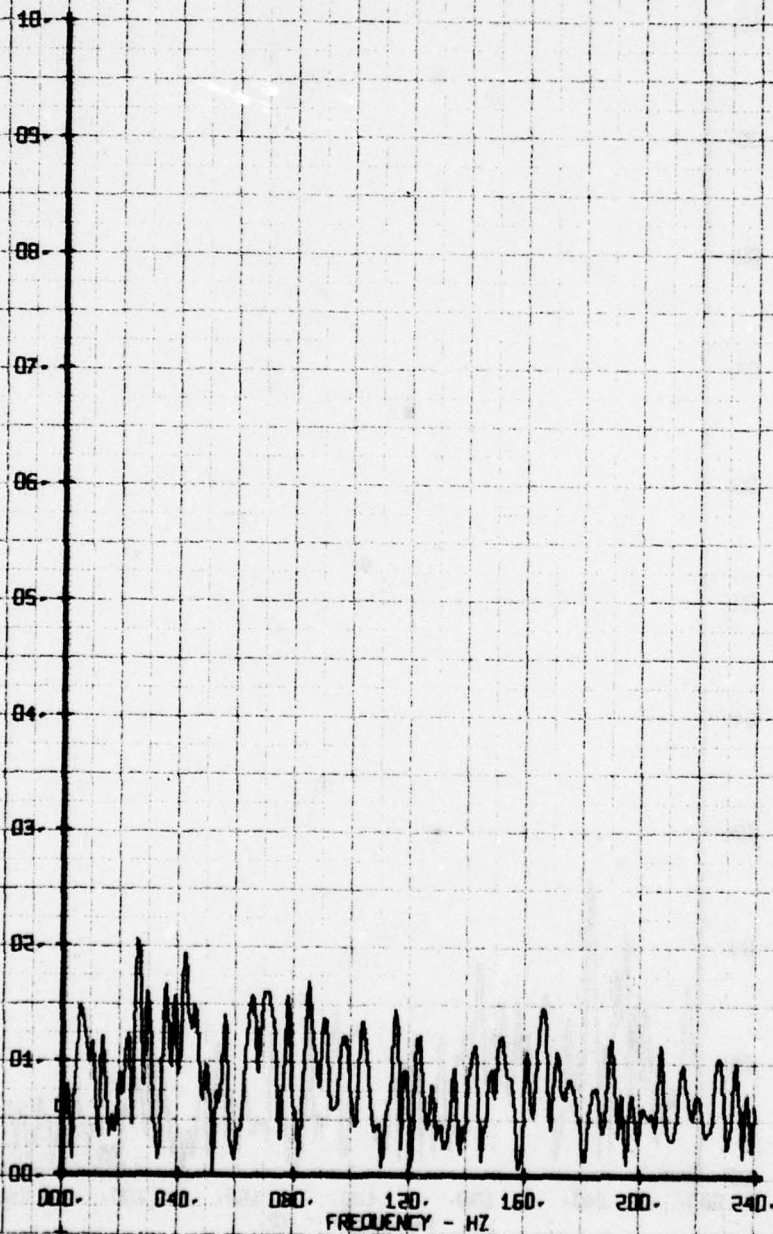
LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF, ROT. HUB
RUN 160 TP 9

LEGEND
CH 66
PARAMETER
ALPHA

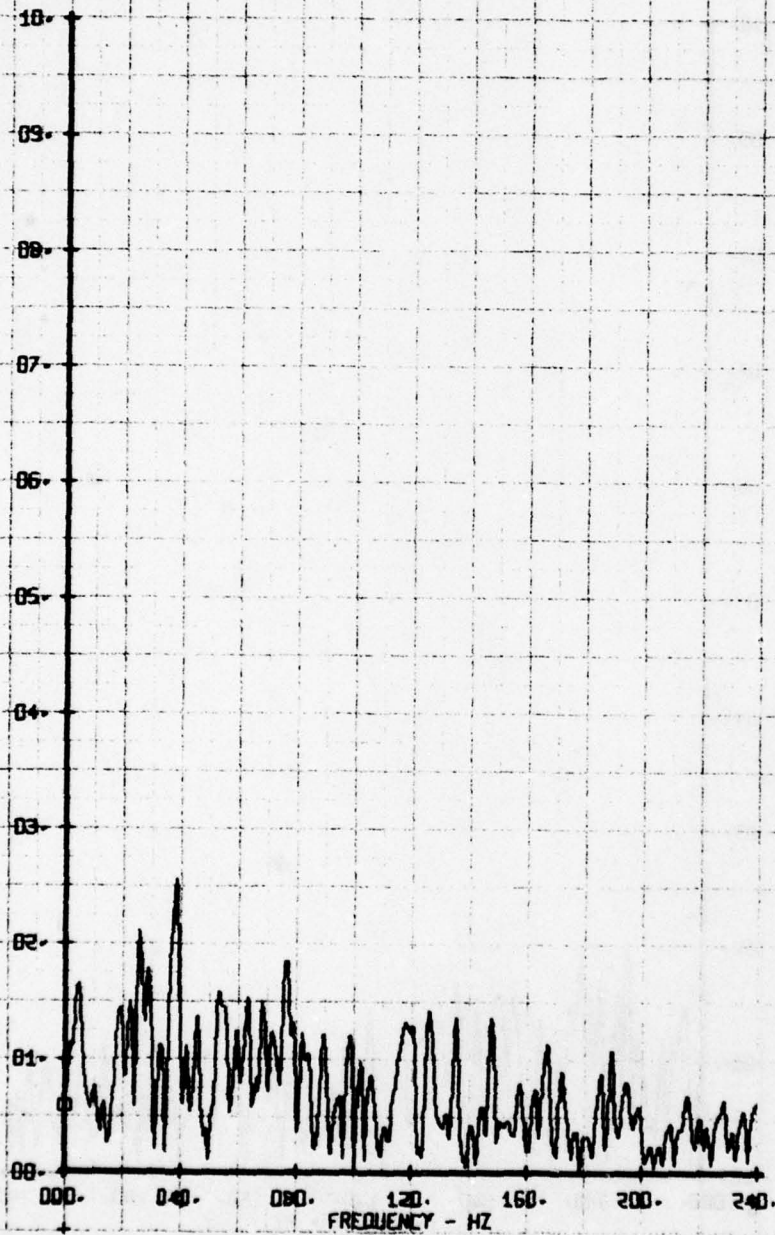
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/10-BLADES DEF. ROT. HUB
RUN 160 TP 10

LEGEND
CH 66
PARAMETER
ALPHA

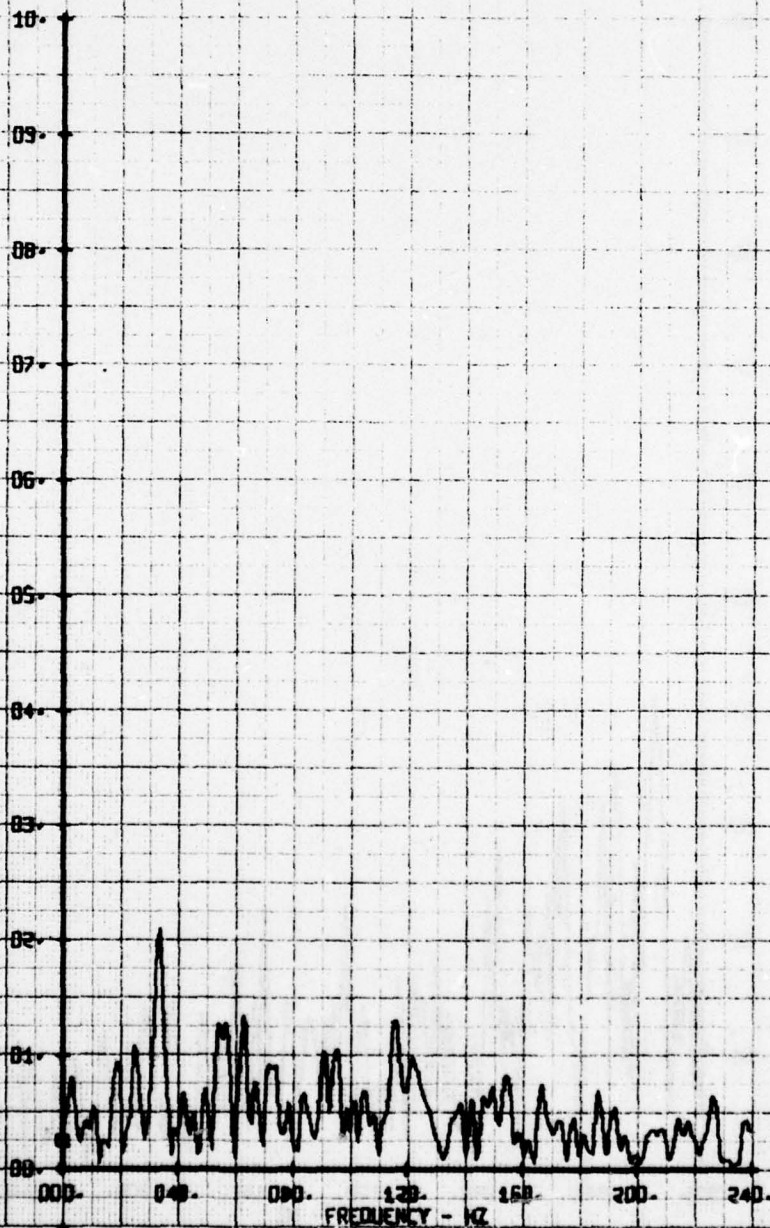
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 11

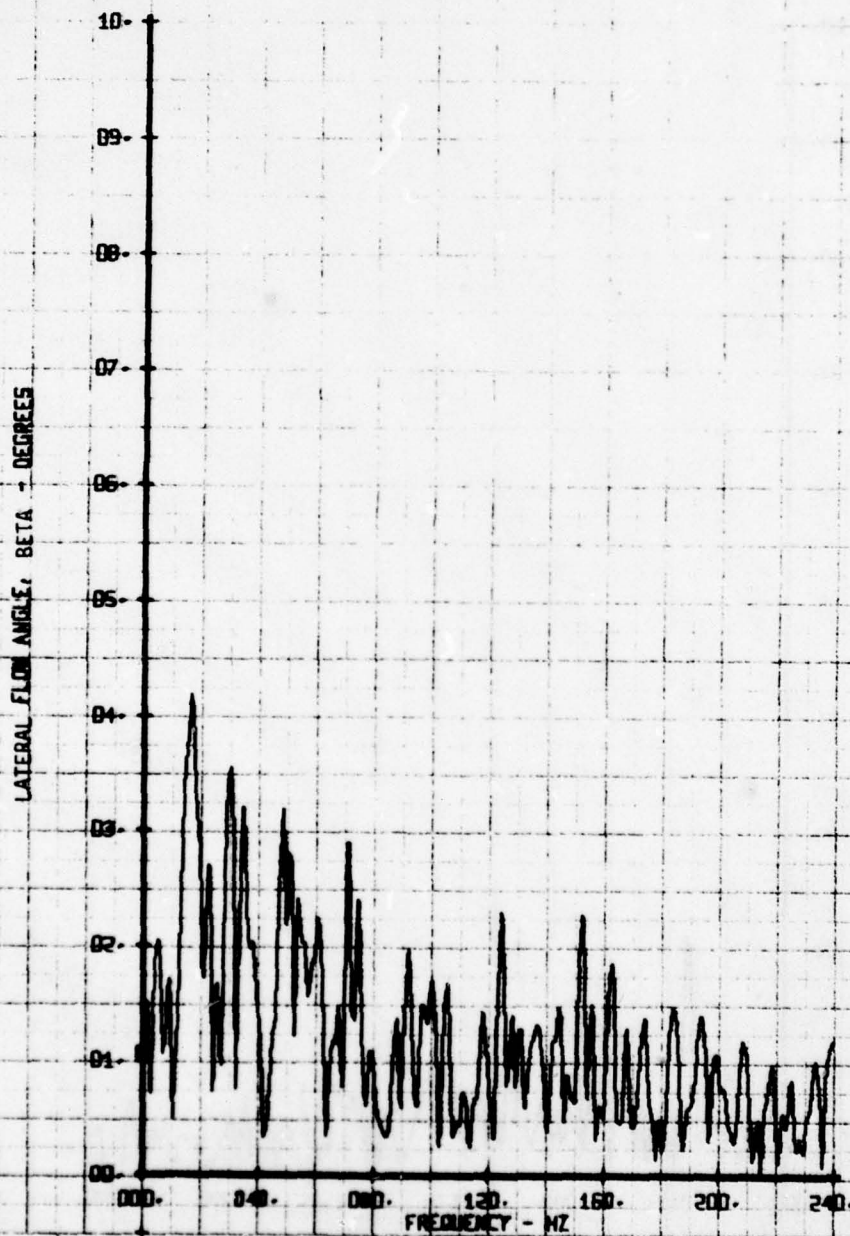
LEGEND
CH 66
PARAMETER
ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 5

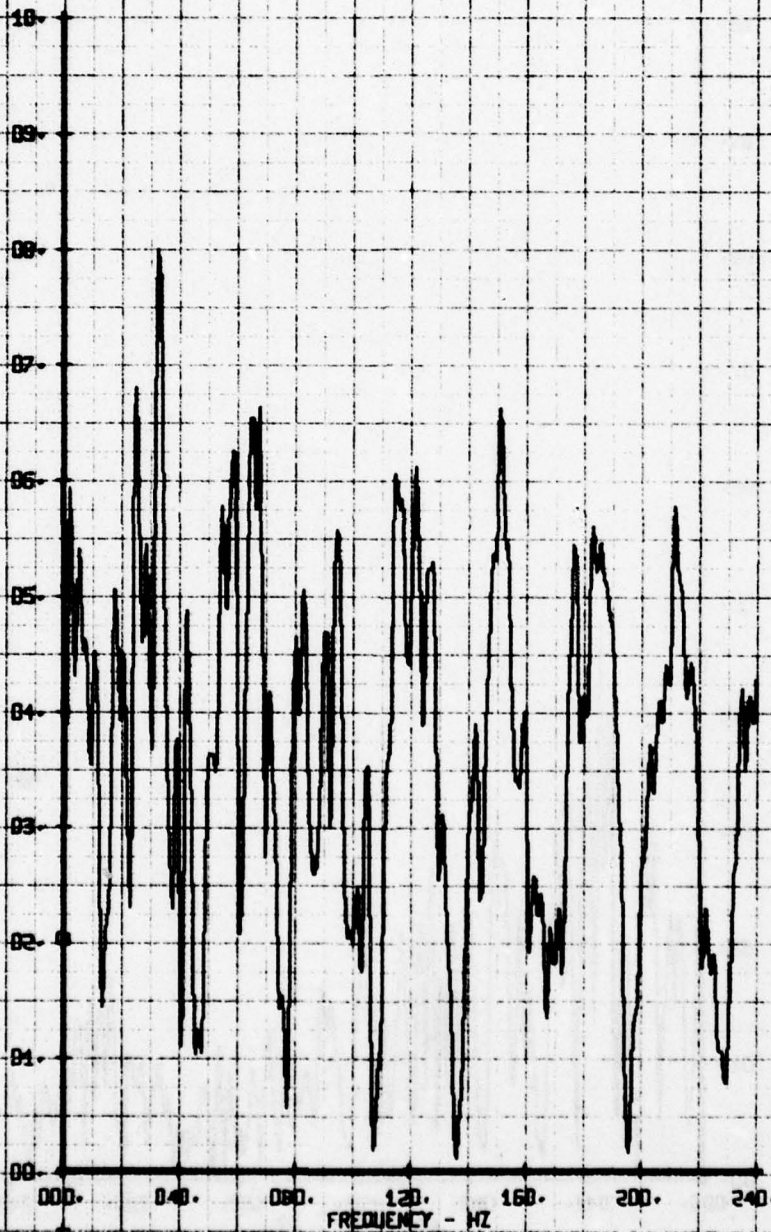
LEGEND
CH PARAMETER
65 BETA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF, ROT. HUB
RUN 160 TP 6

LEGEND
CH PARAMETER
65 BETA

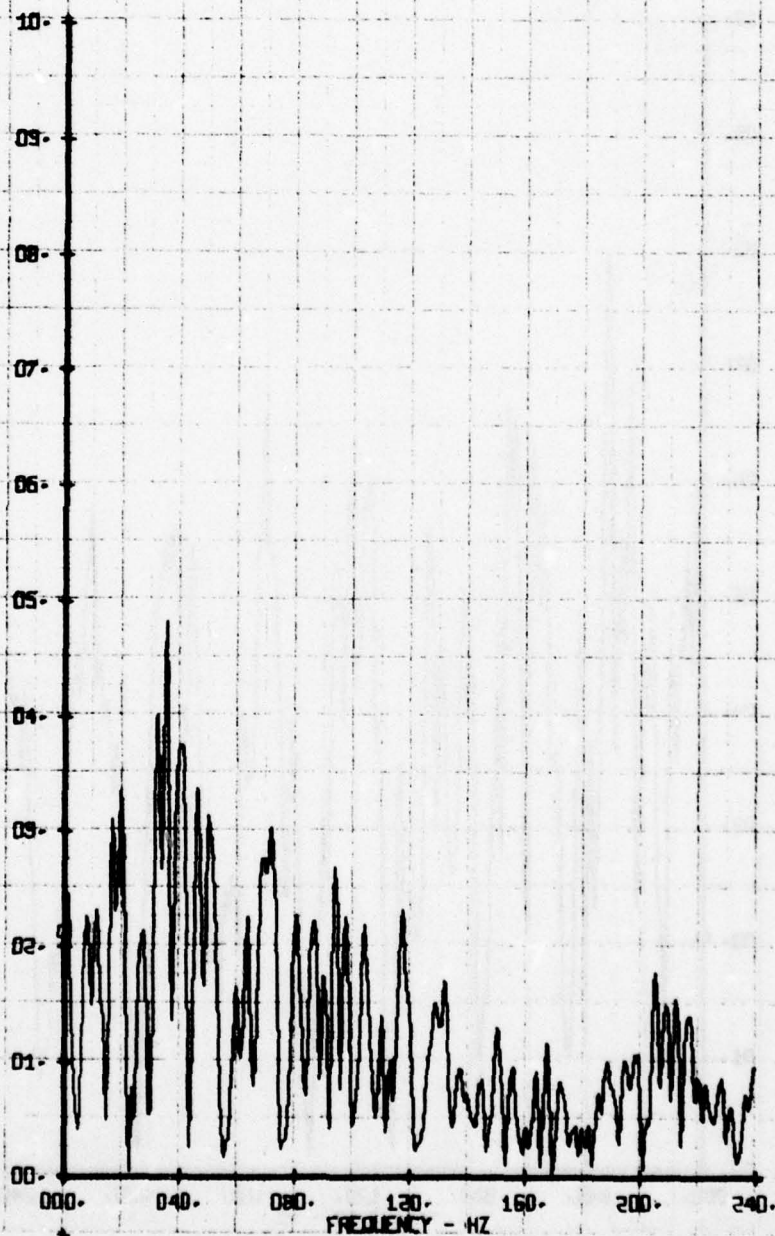
LATERAL FLOW ANGLE, BETA - DEGREES



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE & U-BLADES OFF, ROT-HUB
RUN 160 TP 7

LEGEND
CH 65
PARAMETER
BETA

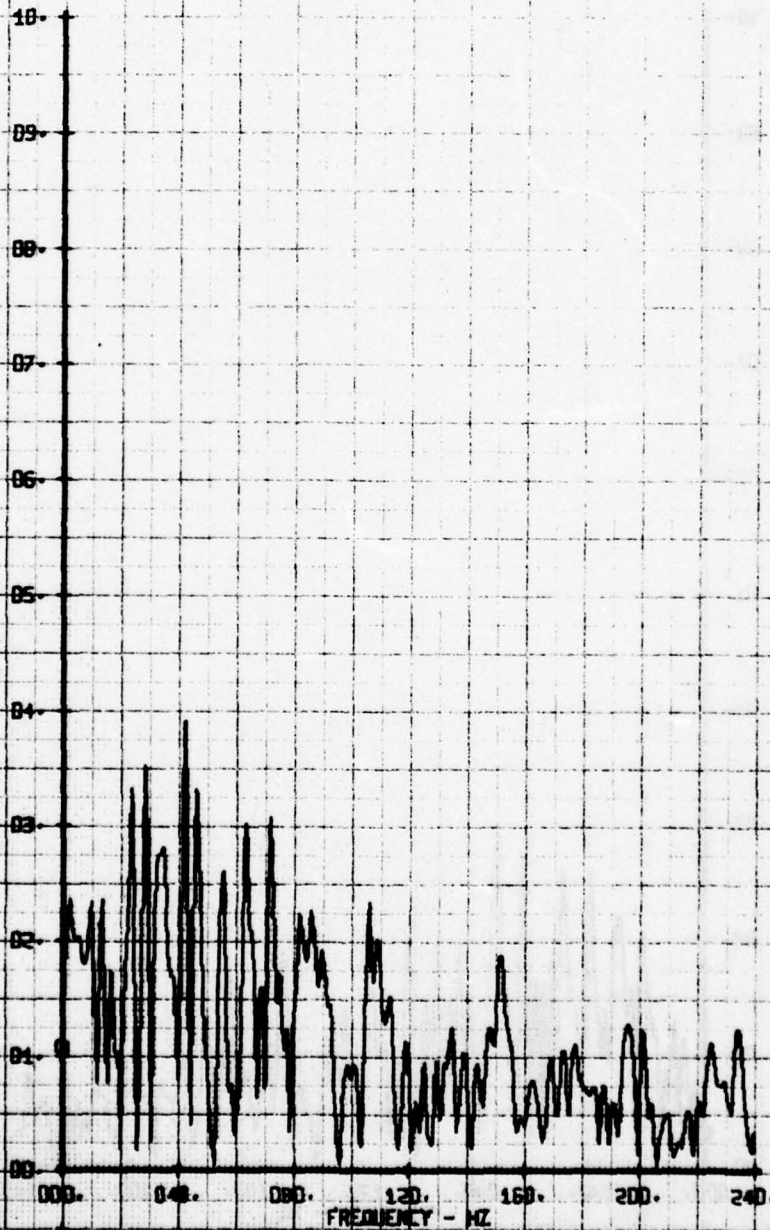
LATERAL FLOW ANGLE, BETA - DEGREES



NOT FILM WARE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 8

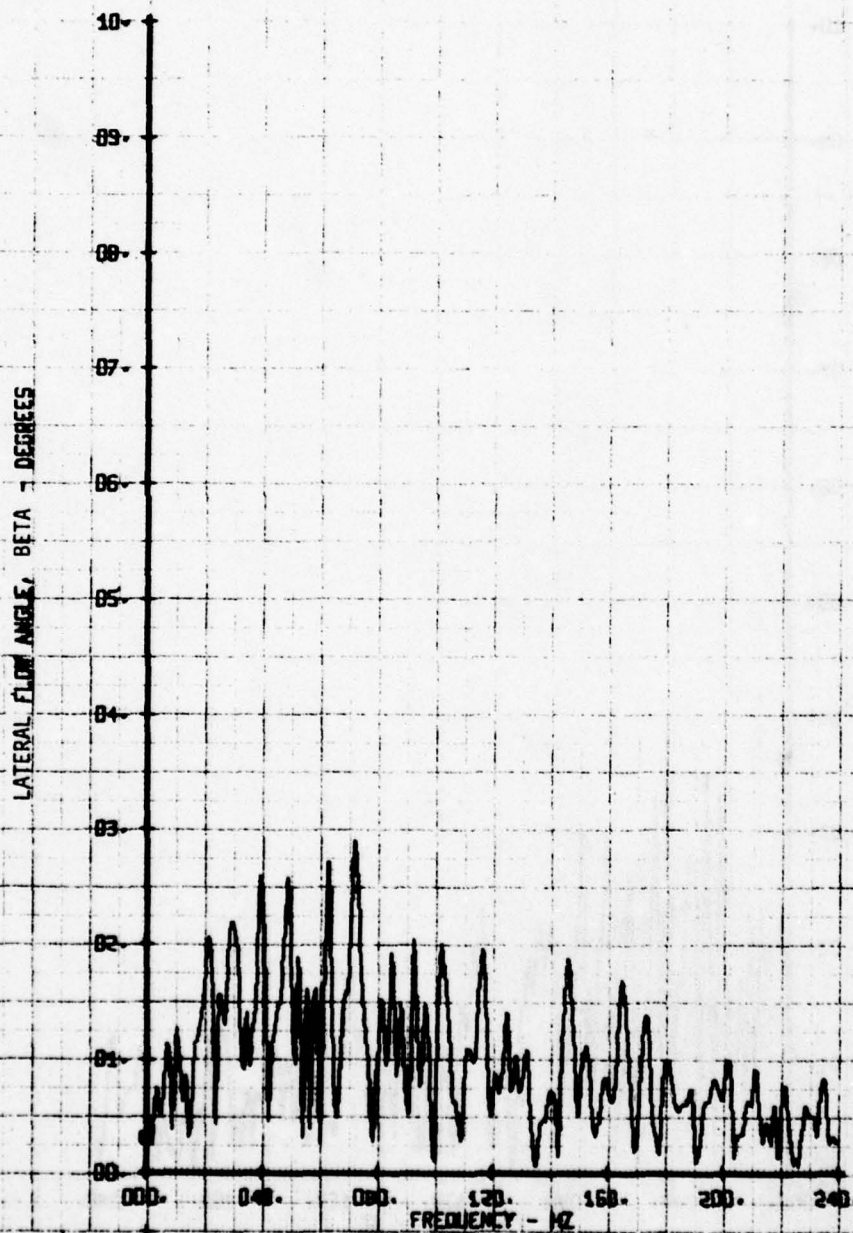
LEGEND
CH 65
PARAMETER
BETA

LATERAL PLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 9

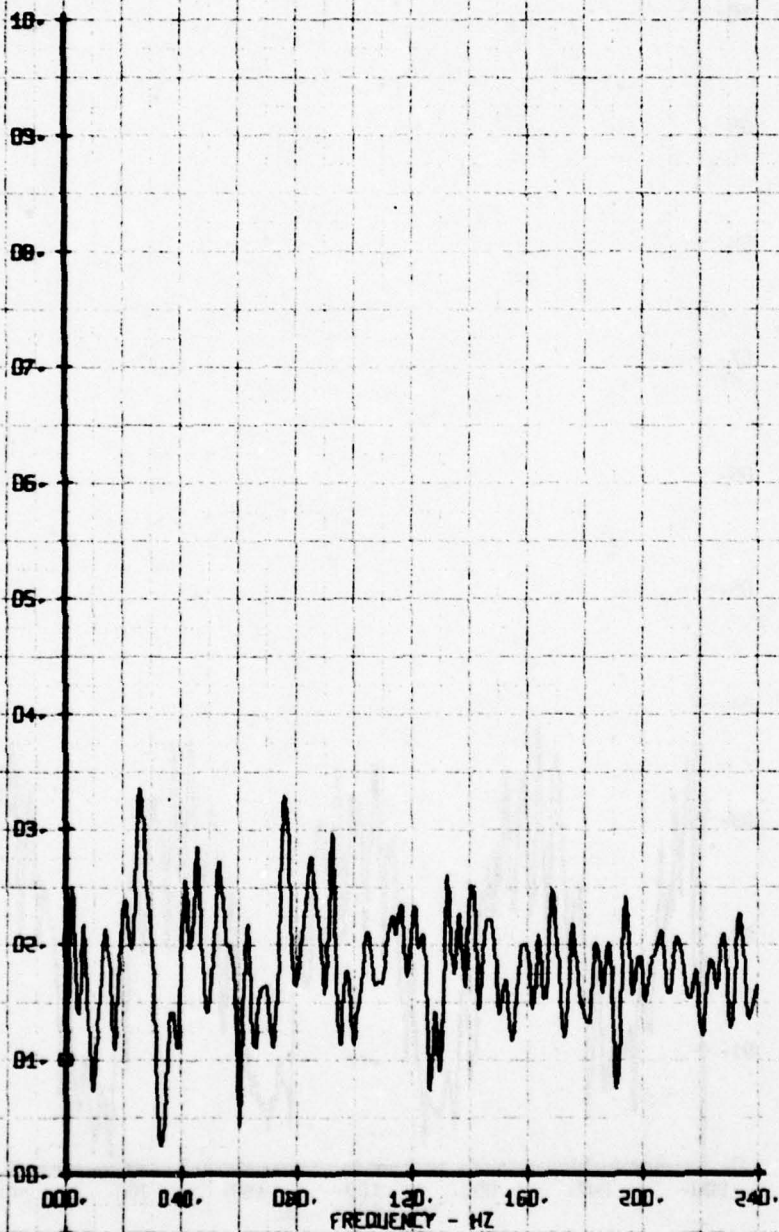
LEGEND
CH PARAMETER
65 BETA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF, ROT. HUB
RUN 160 TP 10

LEGEND
CH 65
PARAMETER
BETA

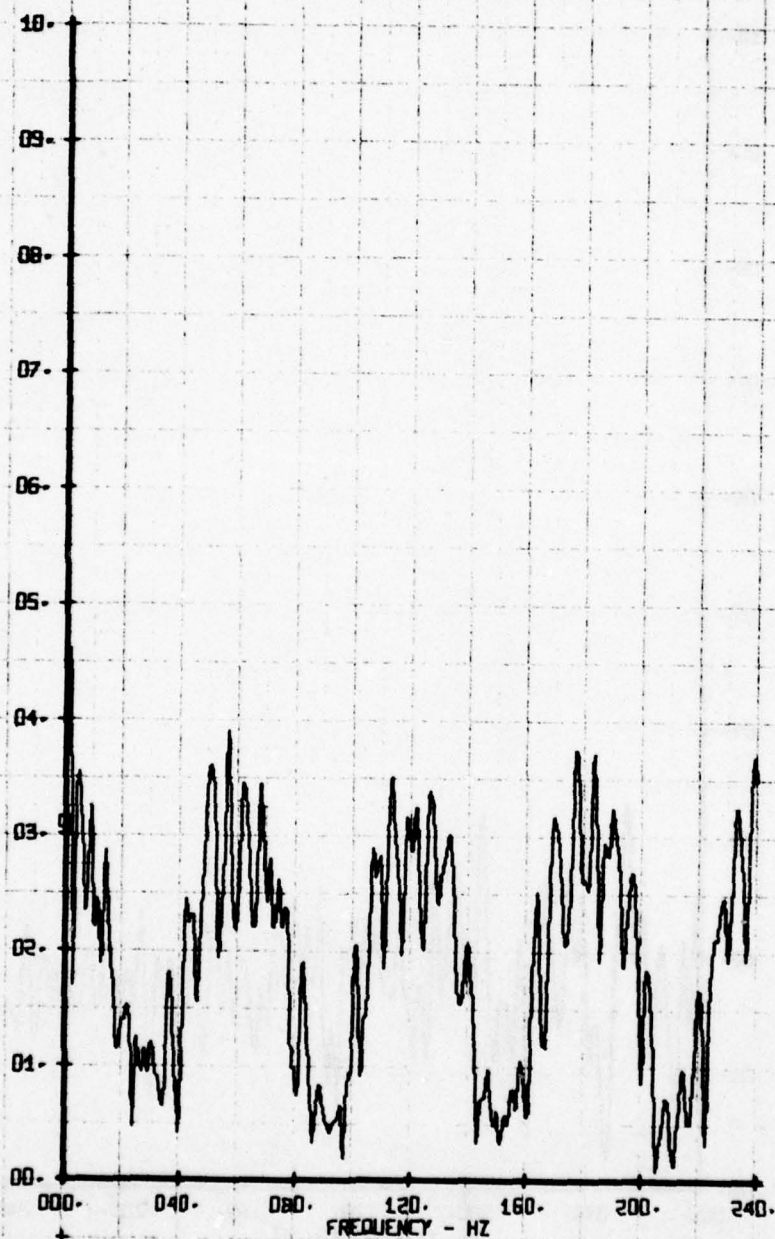
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WIRE FREQUENCY ANALYSIS
BASELINE B/L-BLADES OFF, ROT. HUB
RUN 160 TP 11

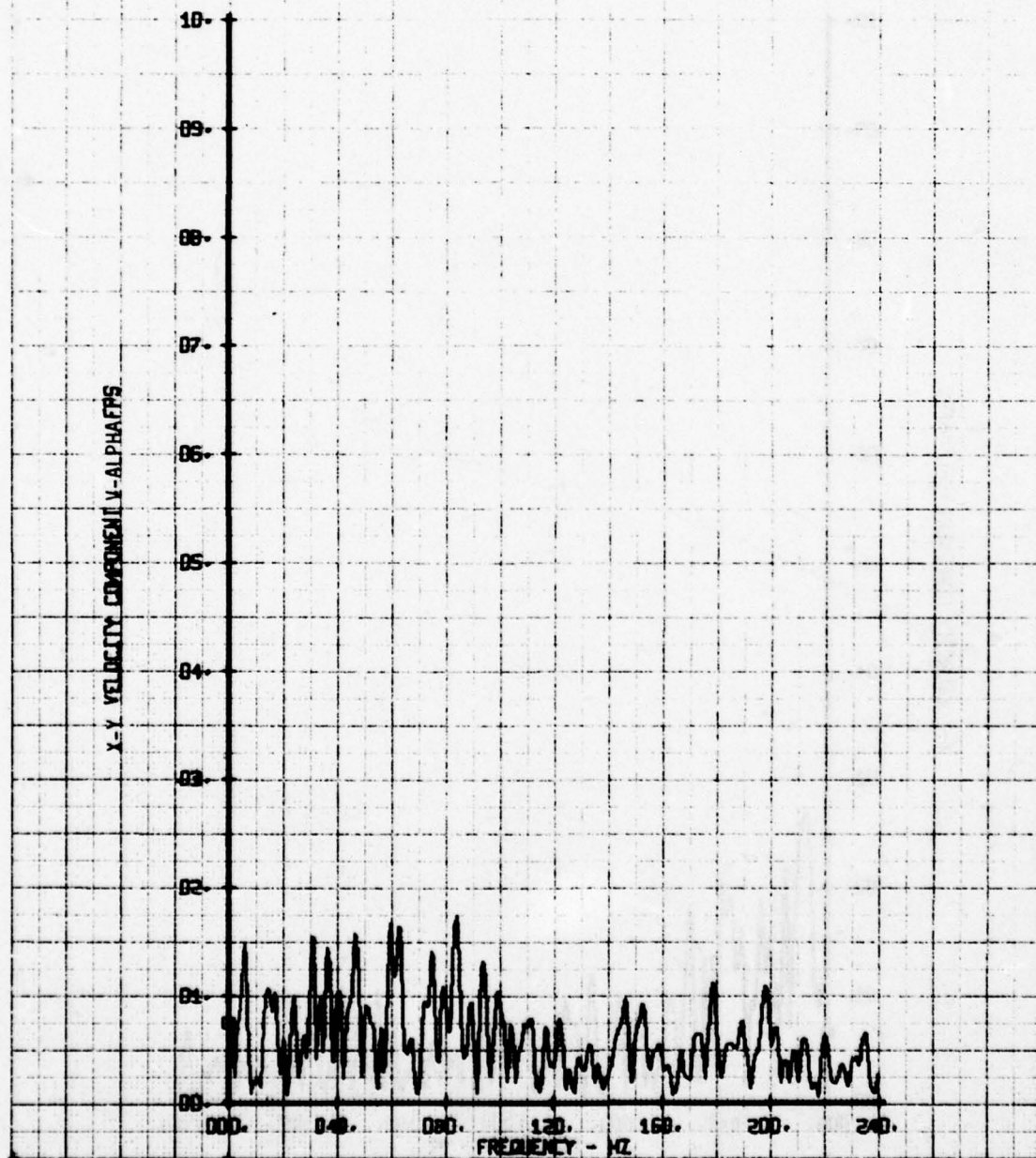
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



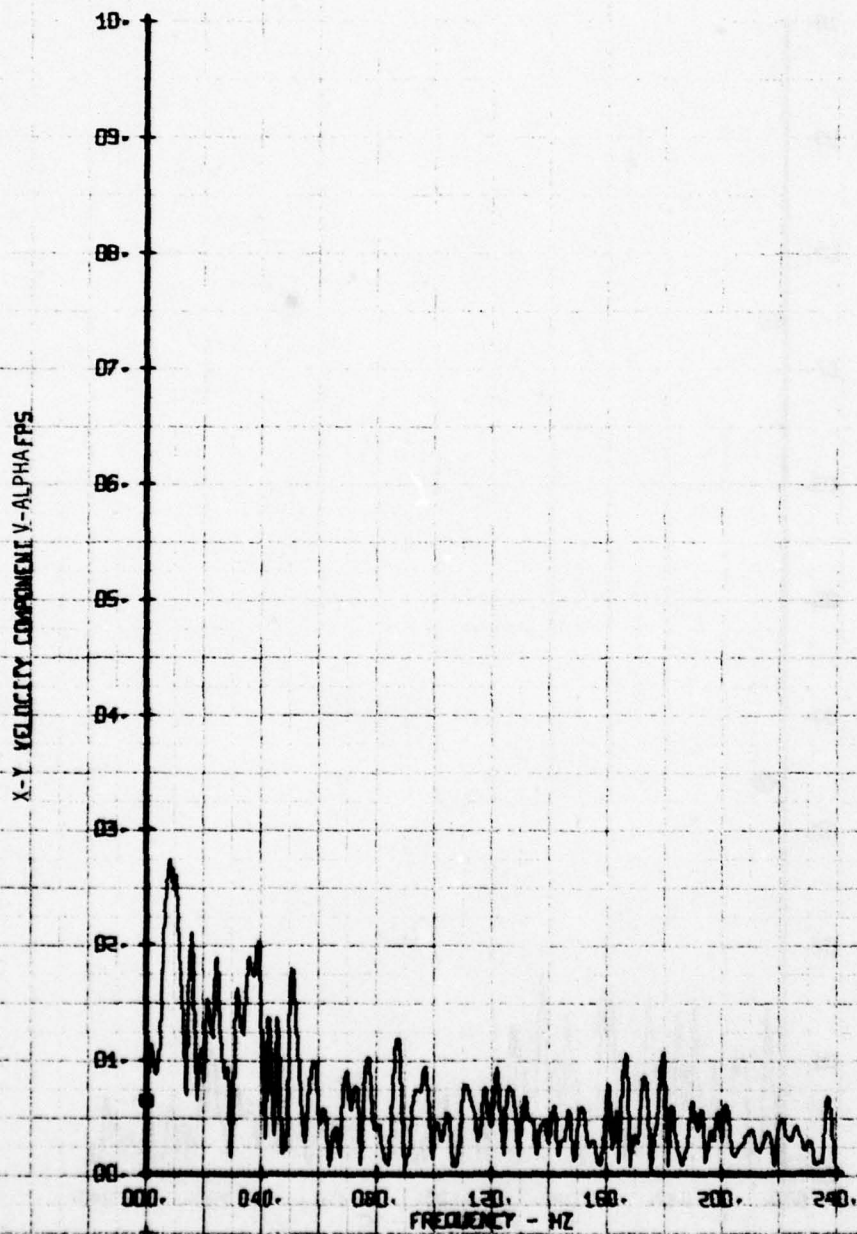
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 5

LEGEND
CH. PARAMETER
66 V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 6

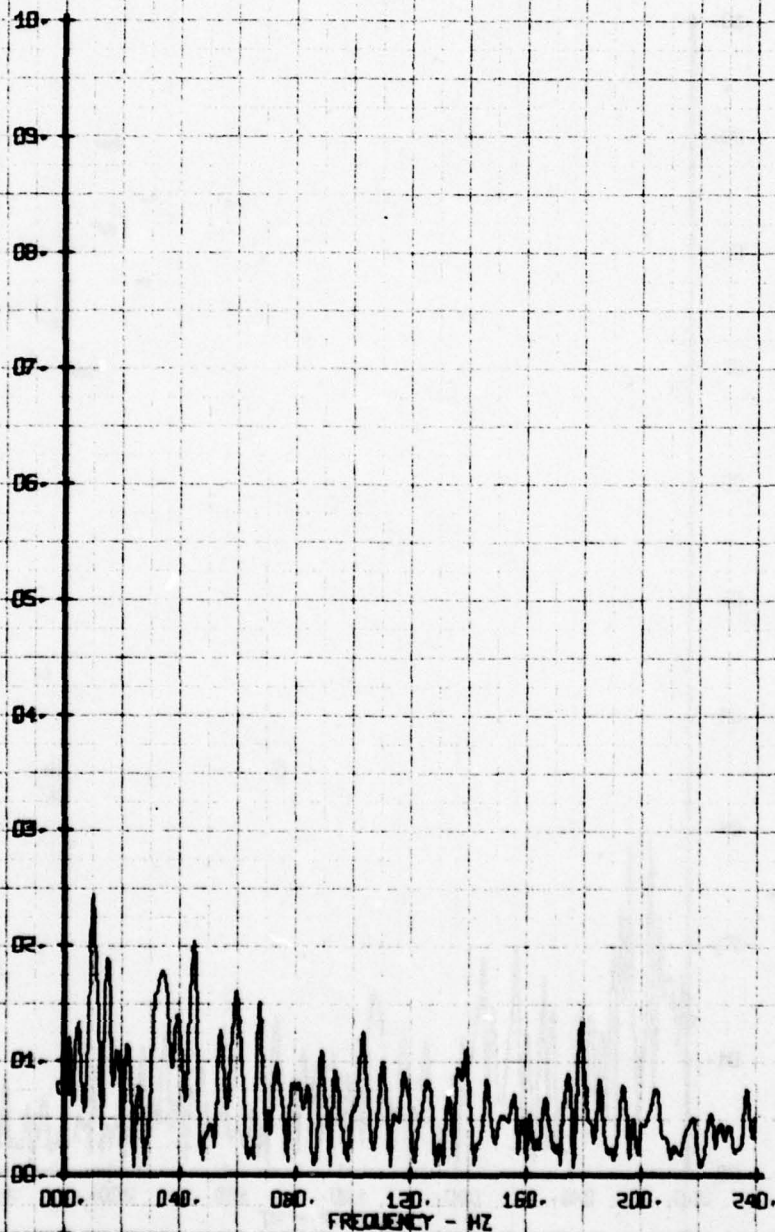
LEGEND
CH PARAMETER
66 V-ALPHA



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF, ROT. HUB
RUN 160 TP 7

LEGEND
CH 66
PARAMETER
V-ALPHA

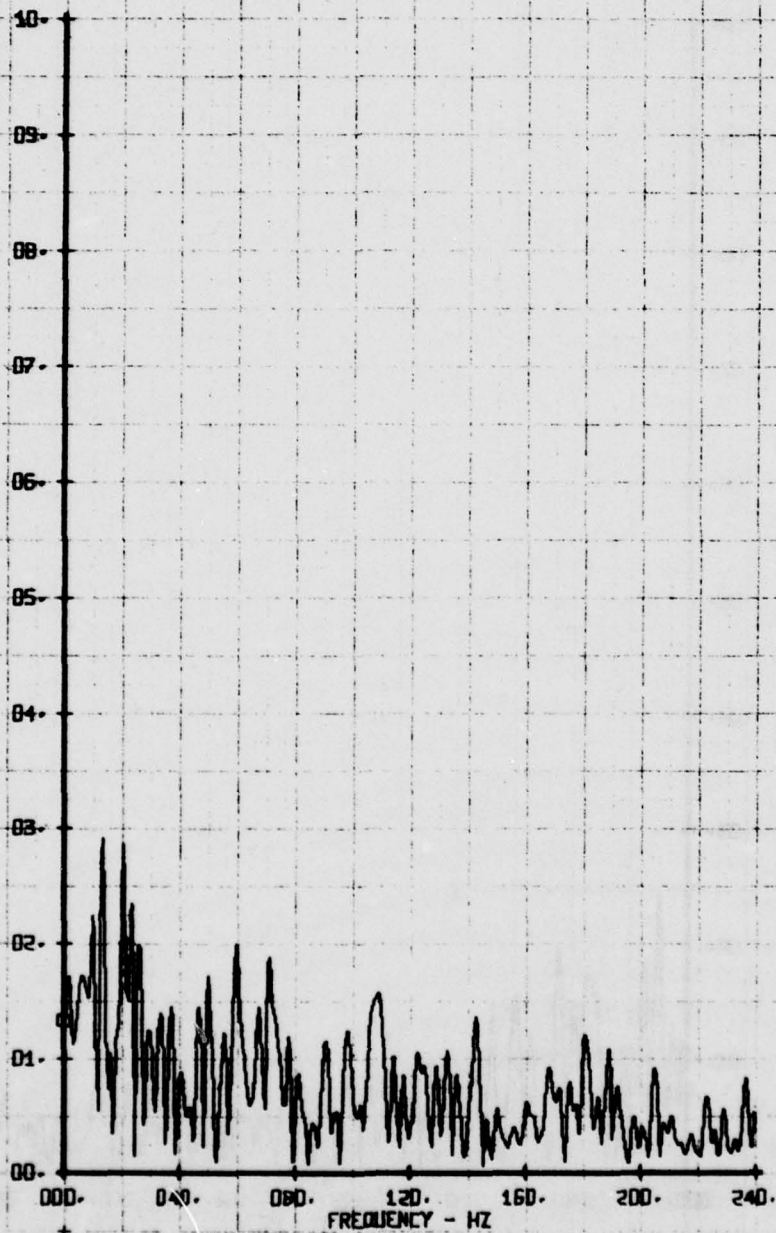
X-Y VELOCITY COMPONENT V-ALPHA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF, ROT. HUB
RUN 160 TP 9

LEGEND
CH. 66
PARAMETER
V-ALPHA

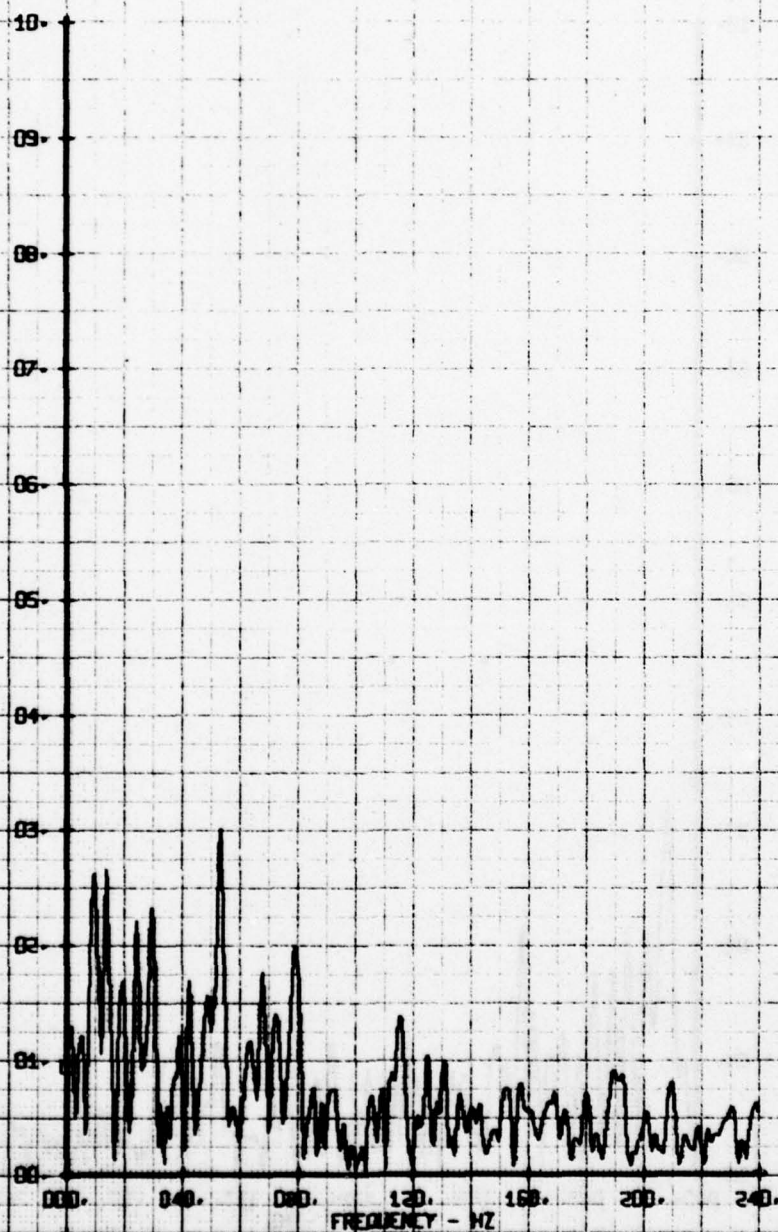
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 9

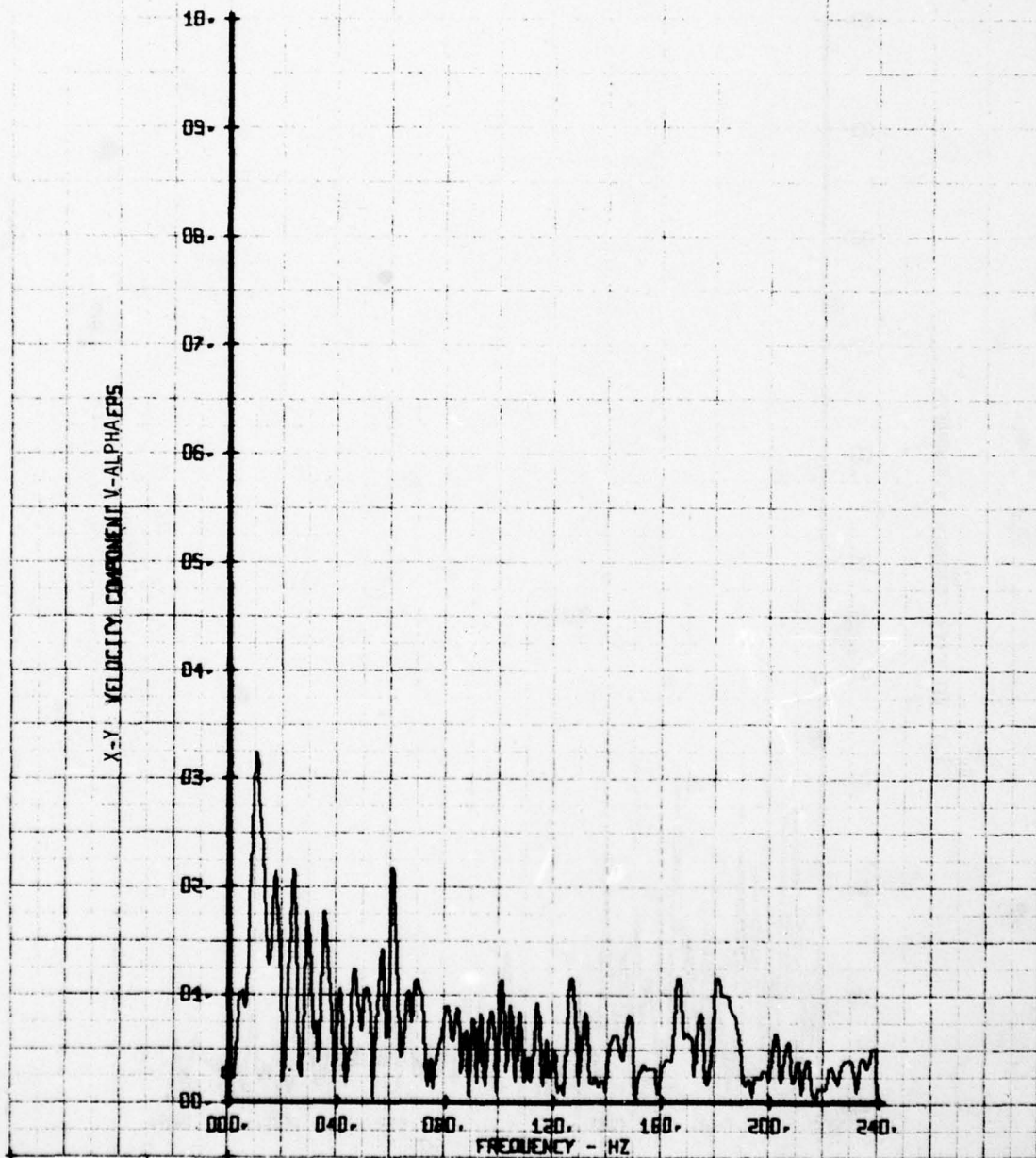
LEGEND
CH PARAMETER
66 V-ALPHA

X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 10

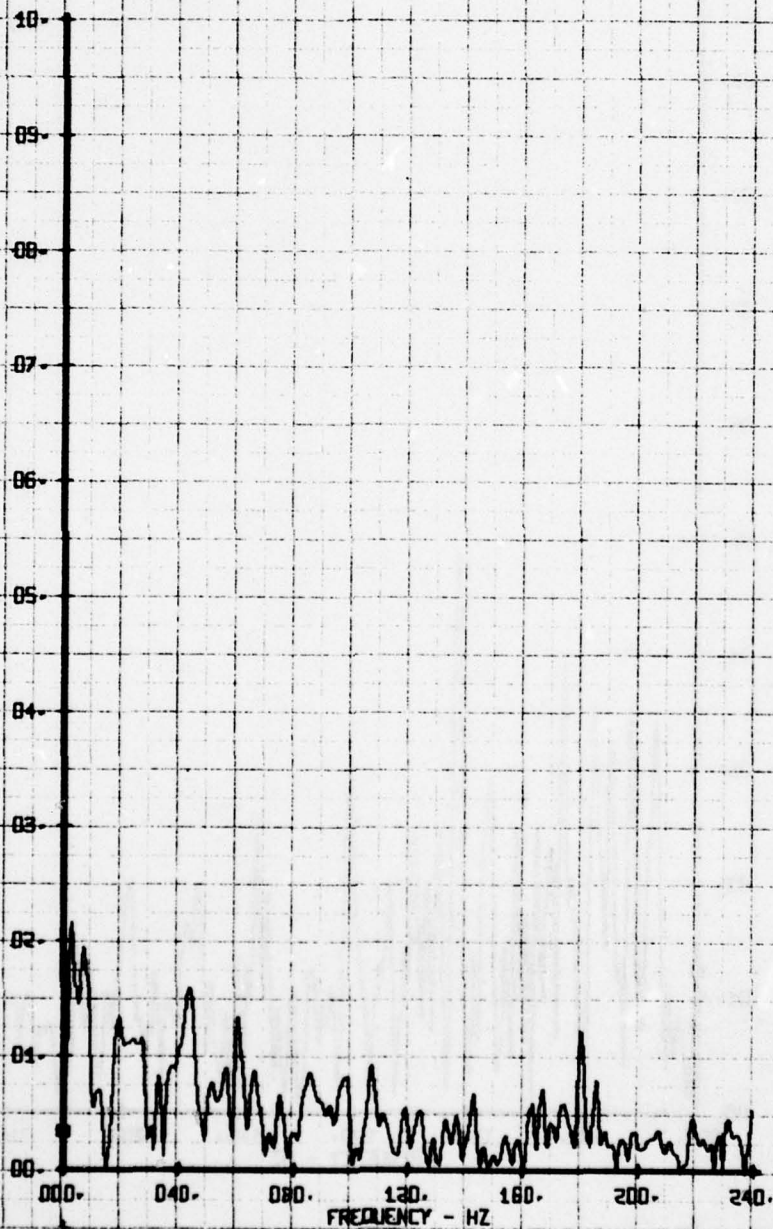
LEGEND
CH 66 PARAMETER
V-ALPHA



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, ROT. HUB
RUN 160 TP 11

LEGEND
CH 66 PARAMETER
V-ALPHA

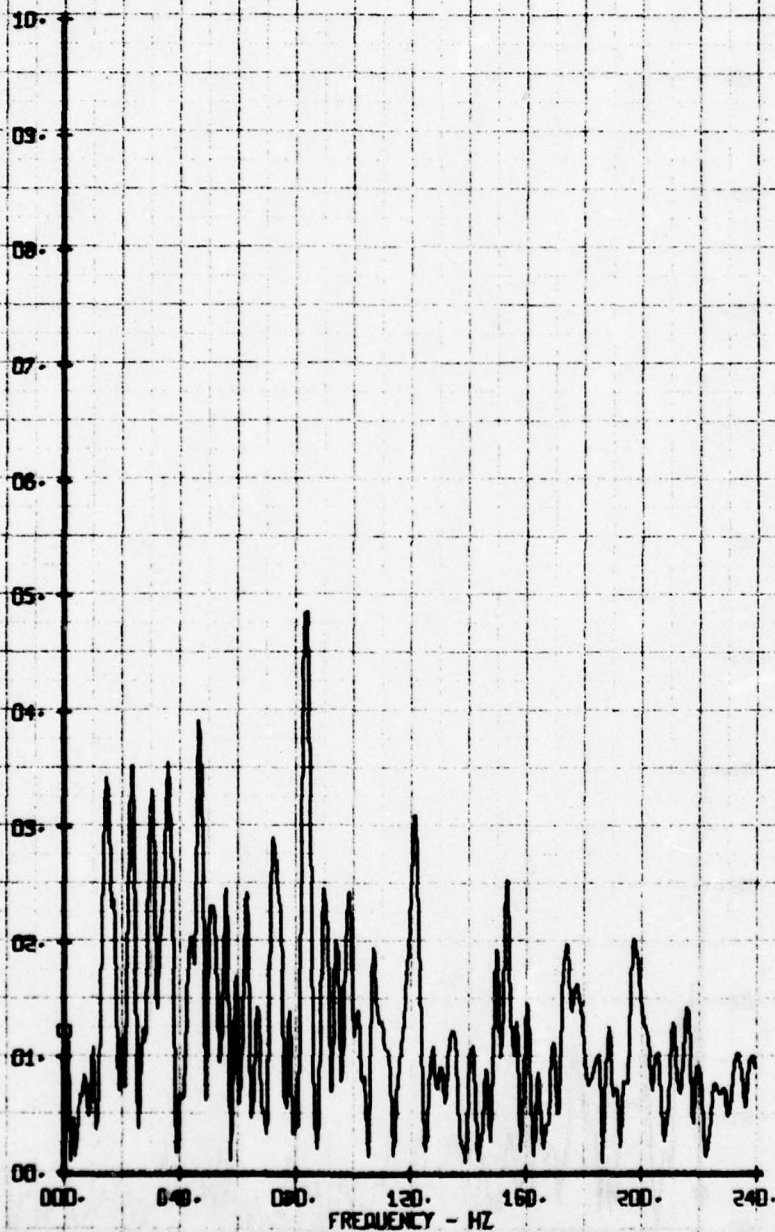
X-Y VELOCITY COMPONENT V-ALPHAFRS



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/41 BLADES OFF, ROT. HUB
RUN 162 TP 5

LEGEND
CH 65
PARAMETER
V-BETA

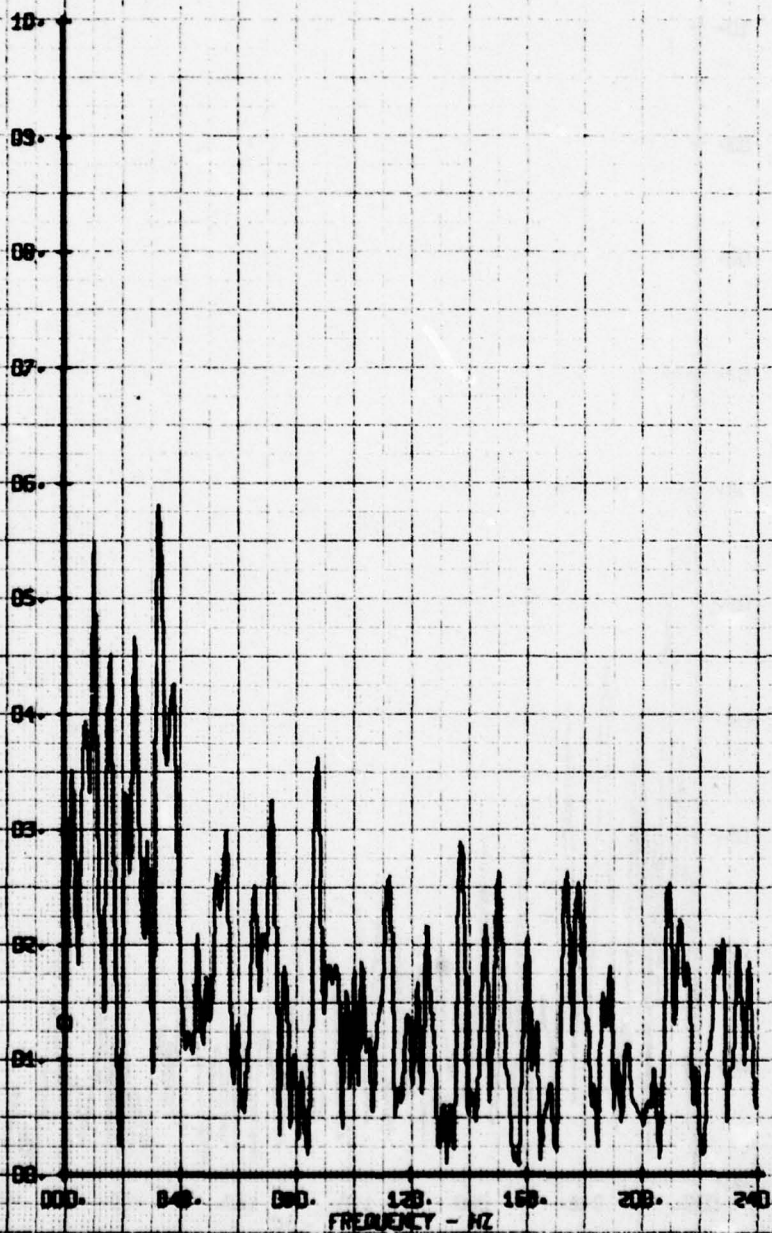
X-Z VELOCITY COMPONENT V-BETA CPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/U-BLADES OFF, ROT, HUB
RUN 160 TP 6

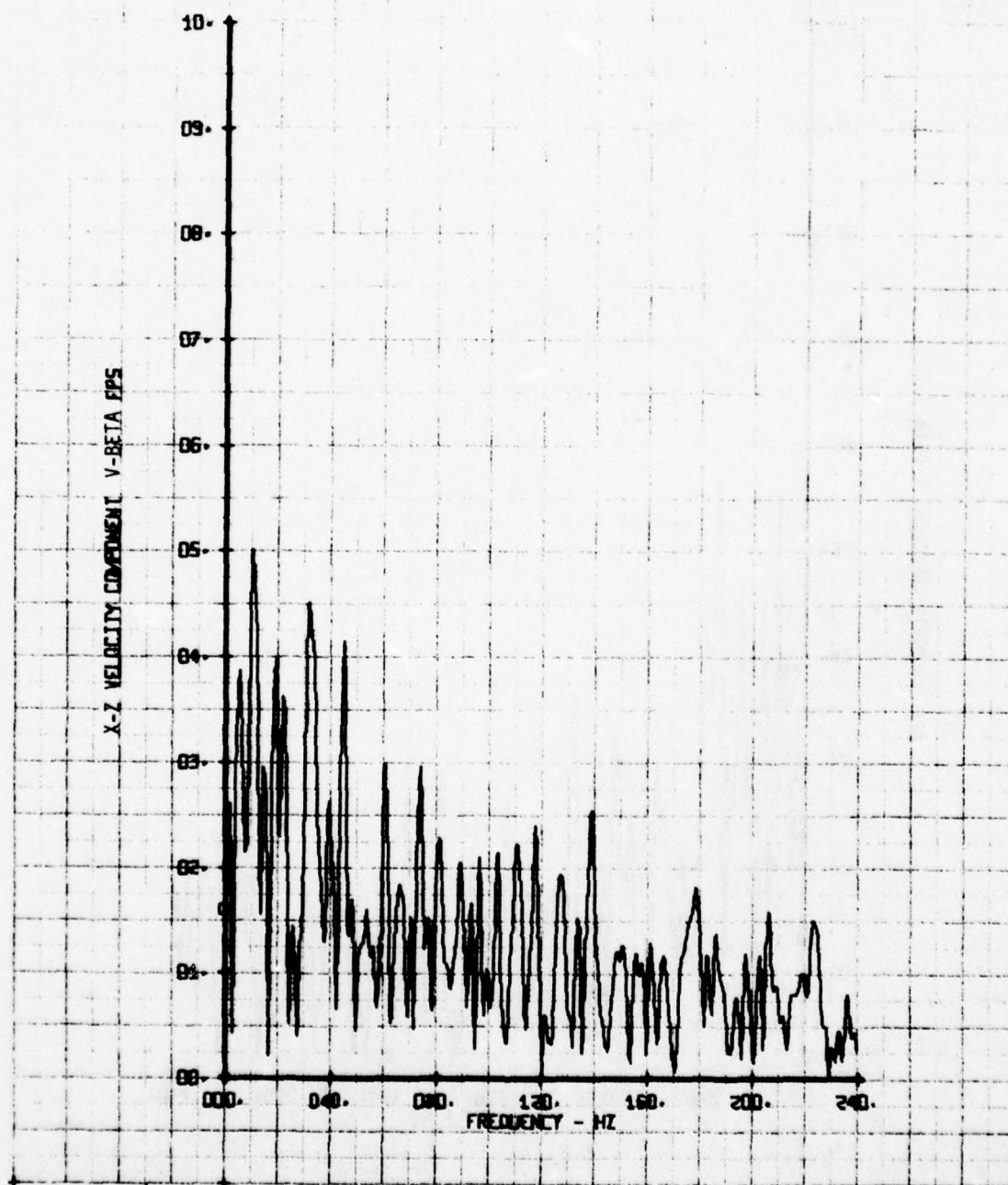
LEGEND
CH 65
PARAMETER
V-BETA

X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/U-BLADES OFF, ROT. HUB
RUN 160 TP 7

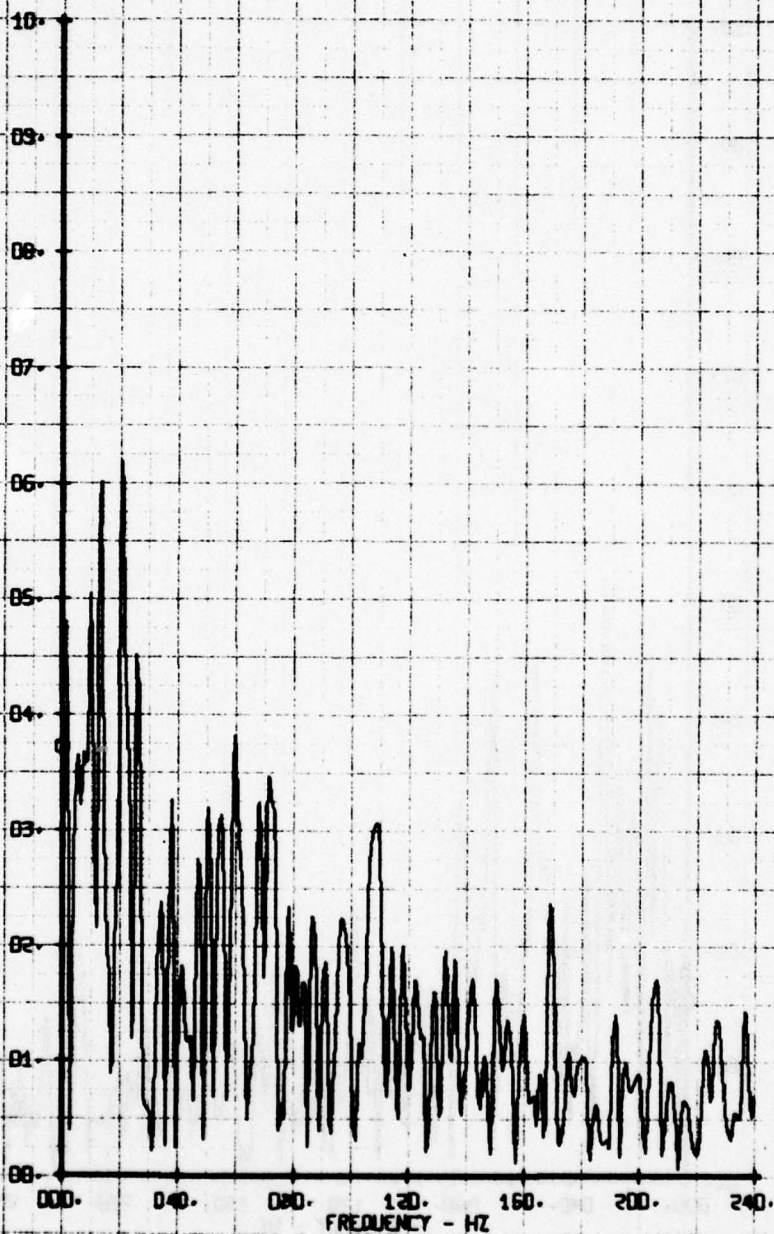
LEGEND
CH 65 PARAMETER
V-BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. HUB
RUN 160 TP 8

LEGEND
CH. 65
PARAMETER
V-BETA

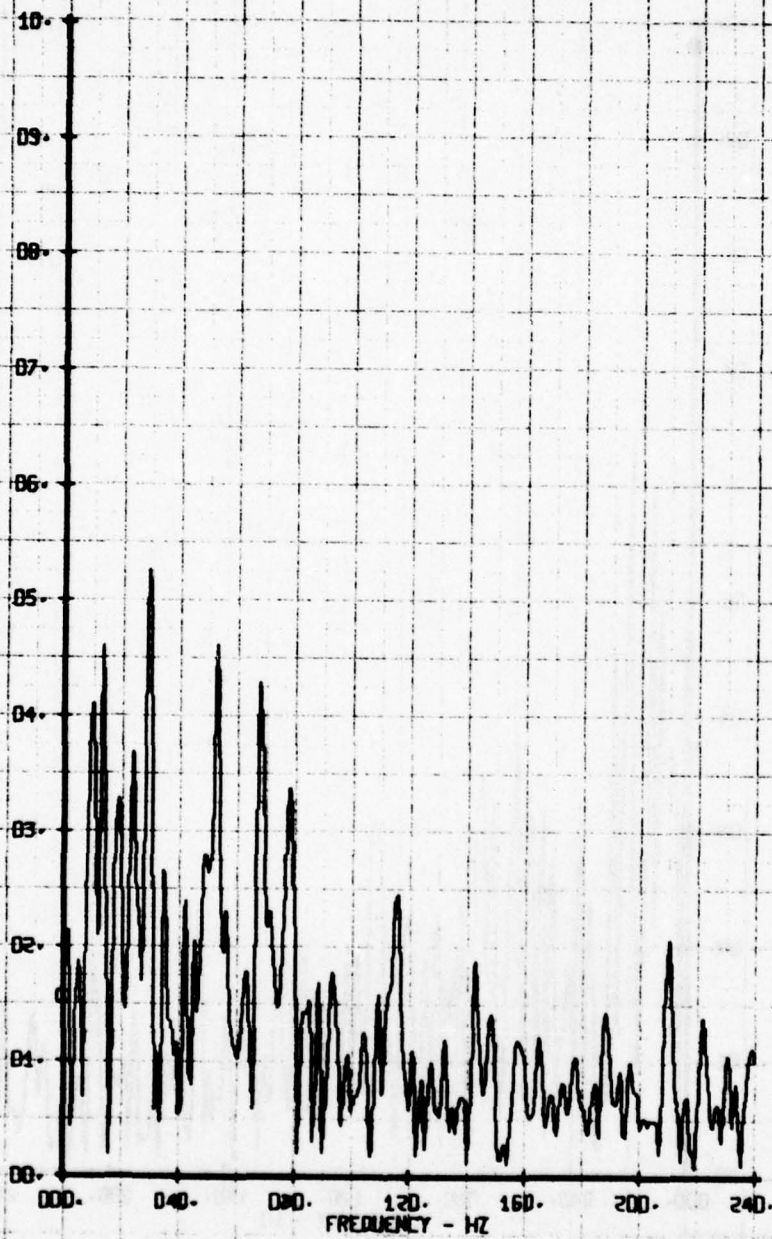
X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, ROT. W/B
RUN 160 TP 9

LEGEND
CH 65
PARAMETER
V-BETA

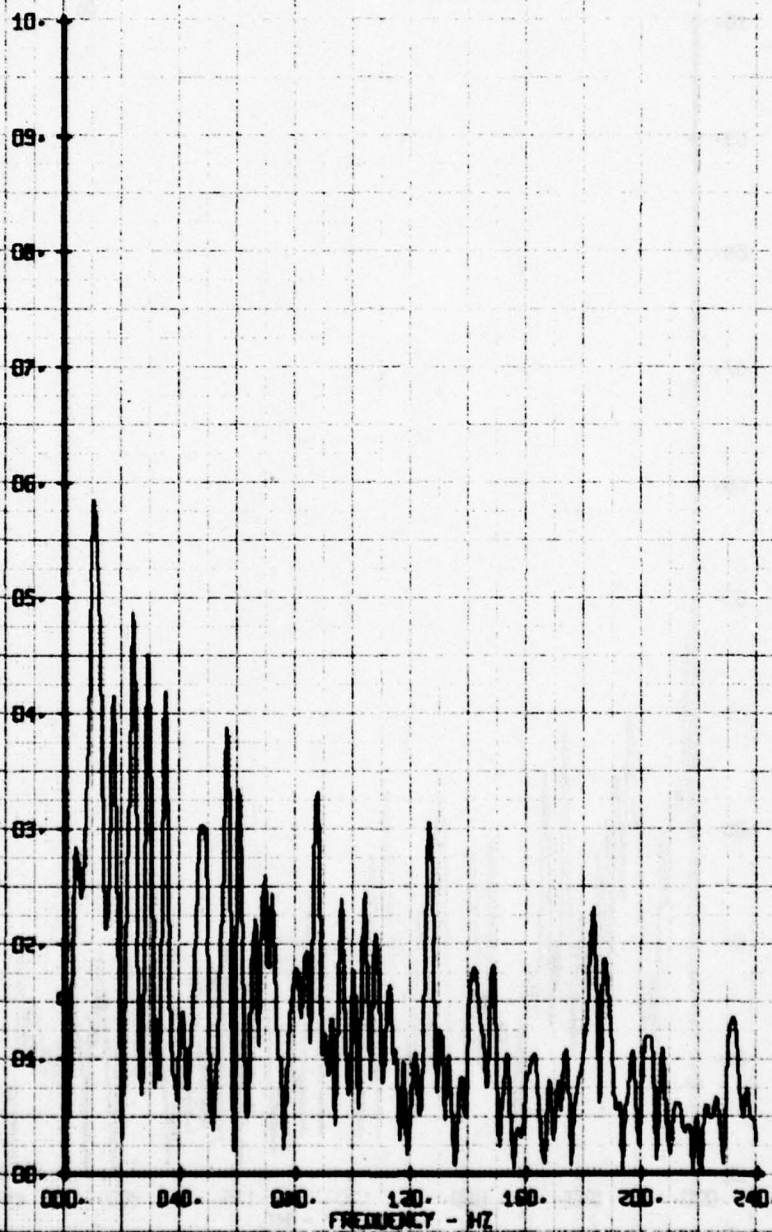
X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, ROT. HUB
RUN 180 TP 10

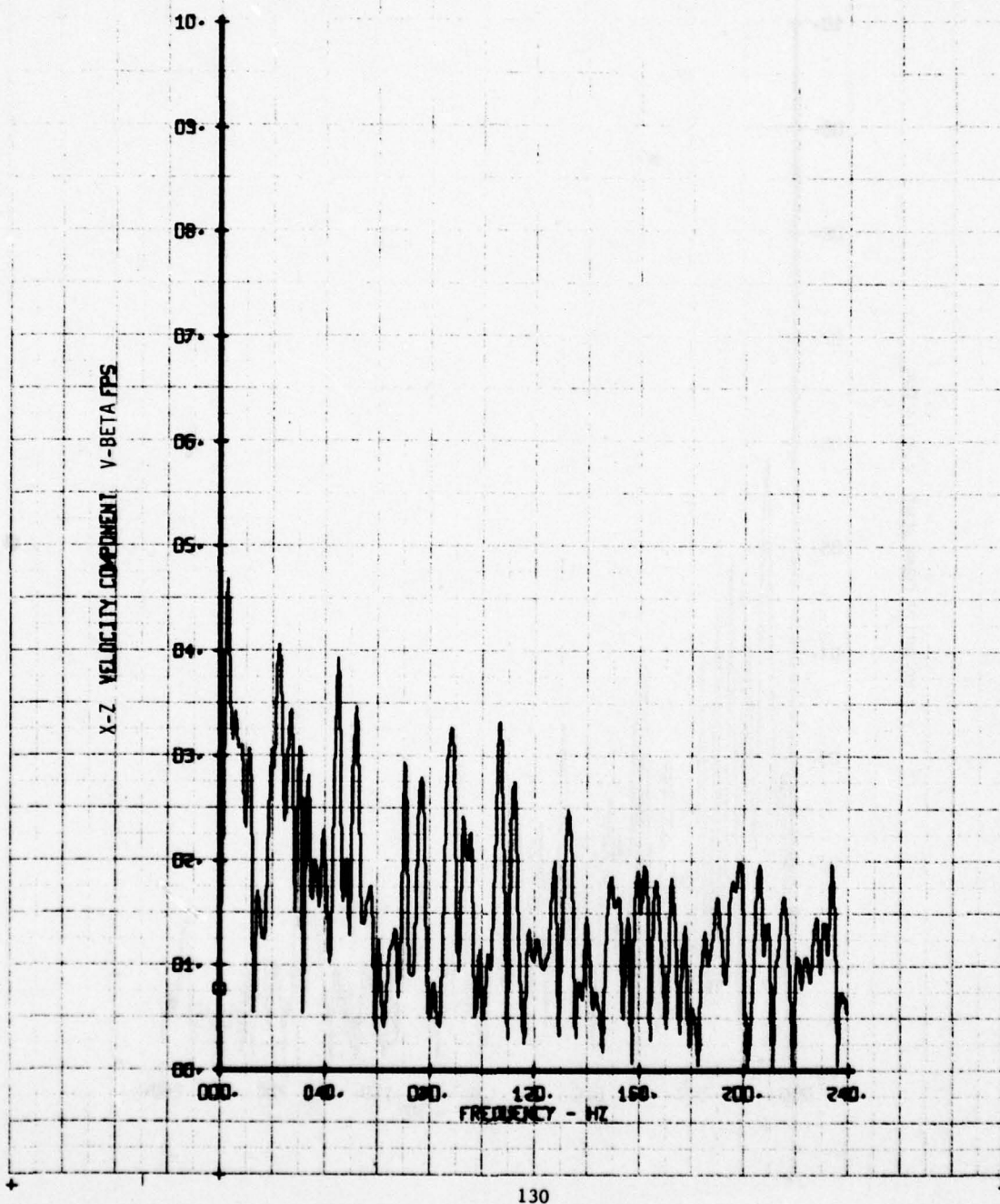
LEGEND
CH. PARAMETER
65 V-BETA

X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/U-BLADES OFF, ROT. HUB
RUN 160 TP 11

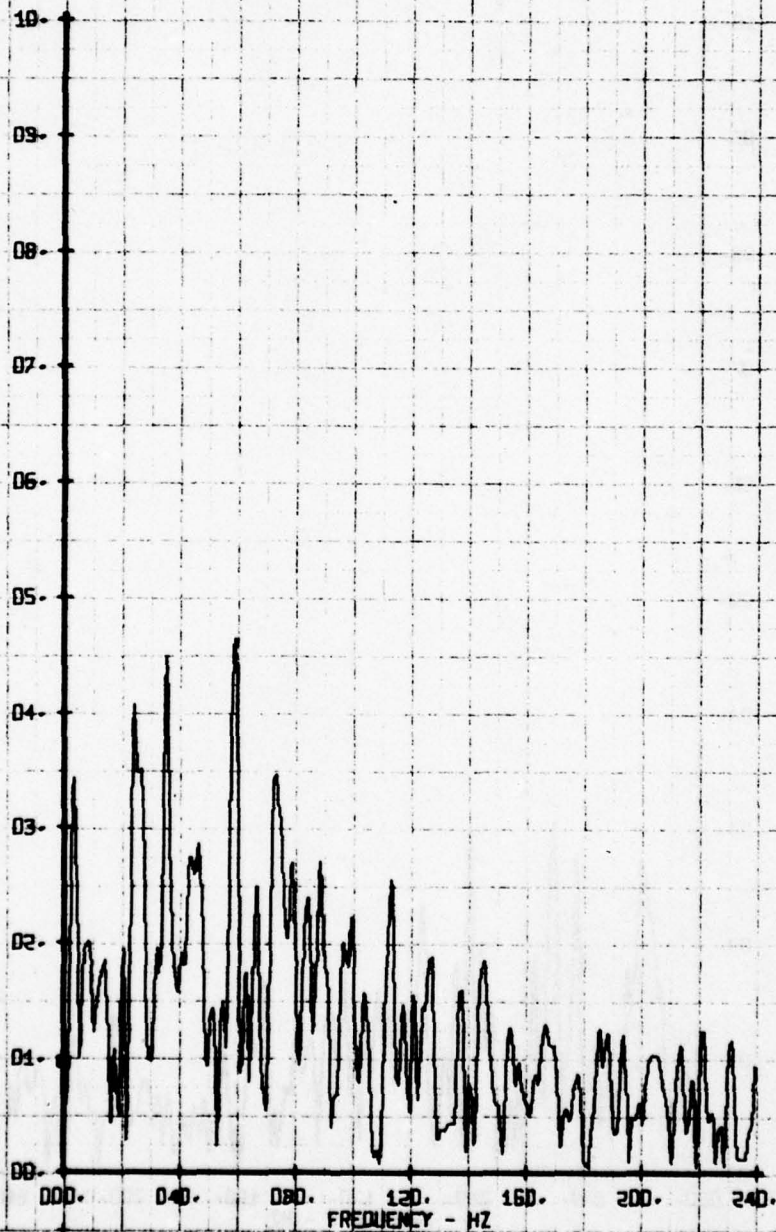
LEGEND
CH PARAMETER
65 V-BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 2

LEGEND
CH 66 PARAMETER
ALPHA

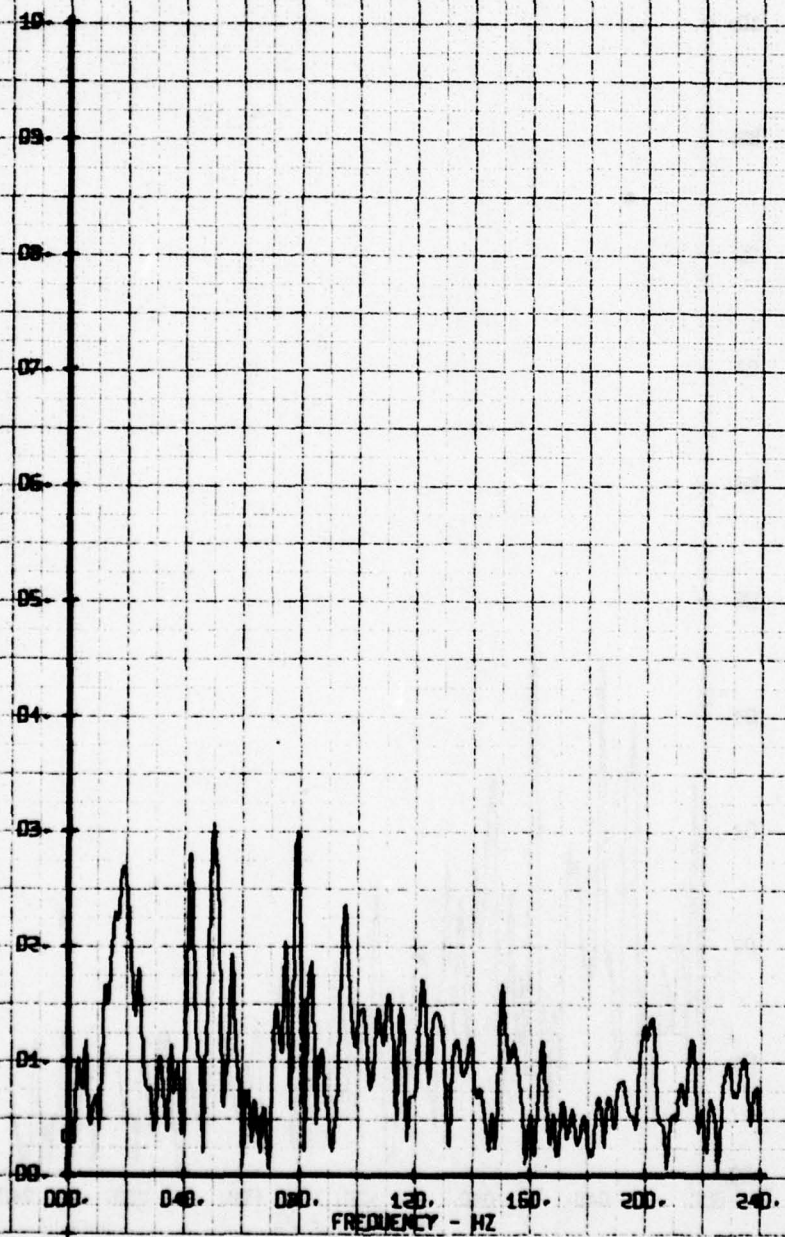
VERTICAL FLOW ANGLE, ALPHA-DEGREES



HOT FILM WIRE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARM
RUN 156 TP 3

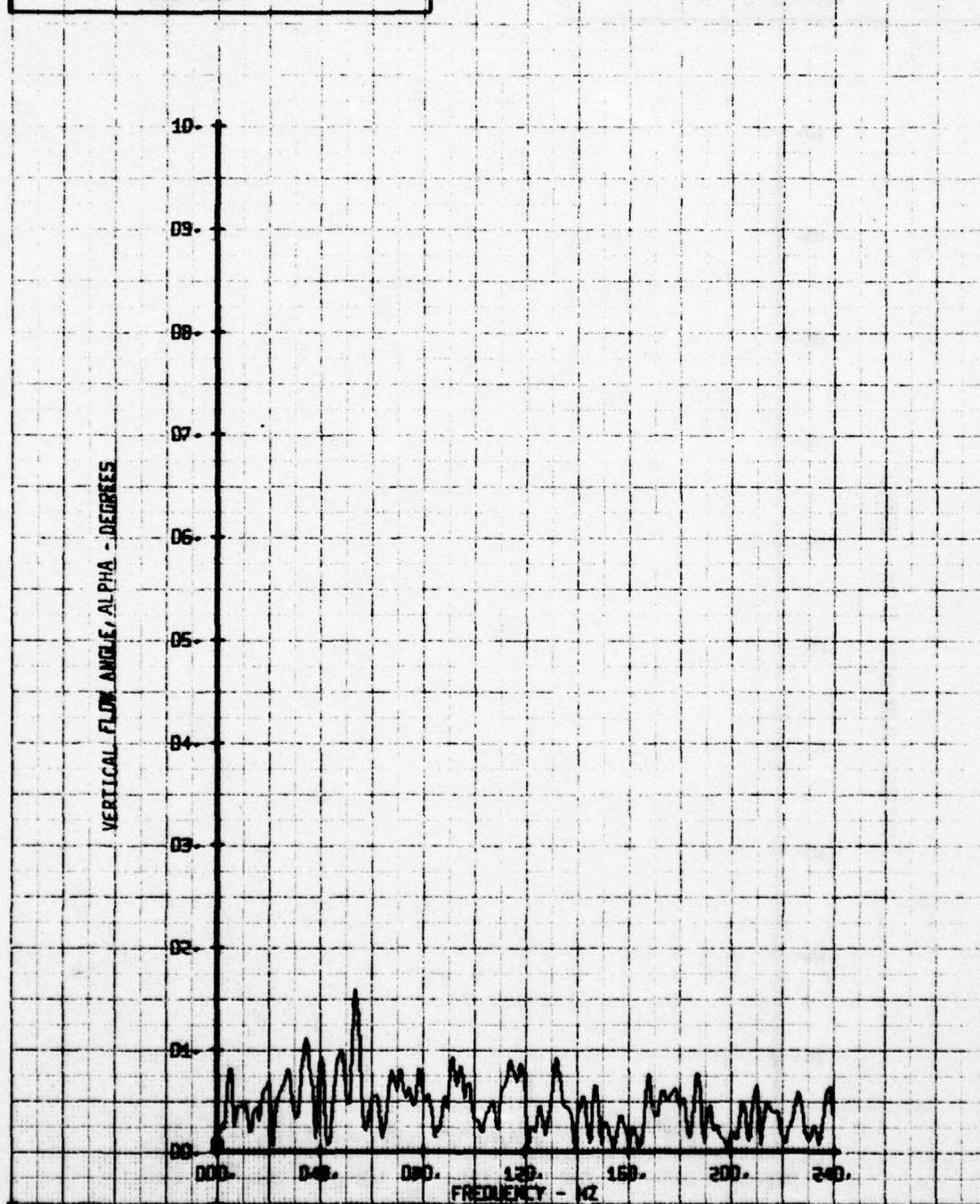
LEGEND
CH 66
PARAMETER
ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



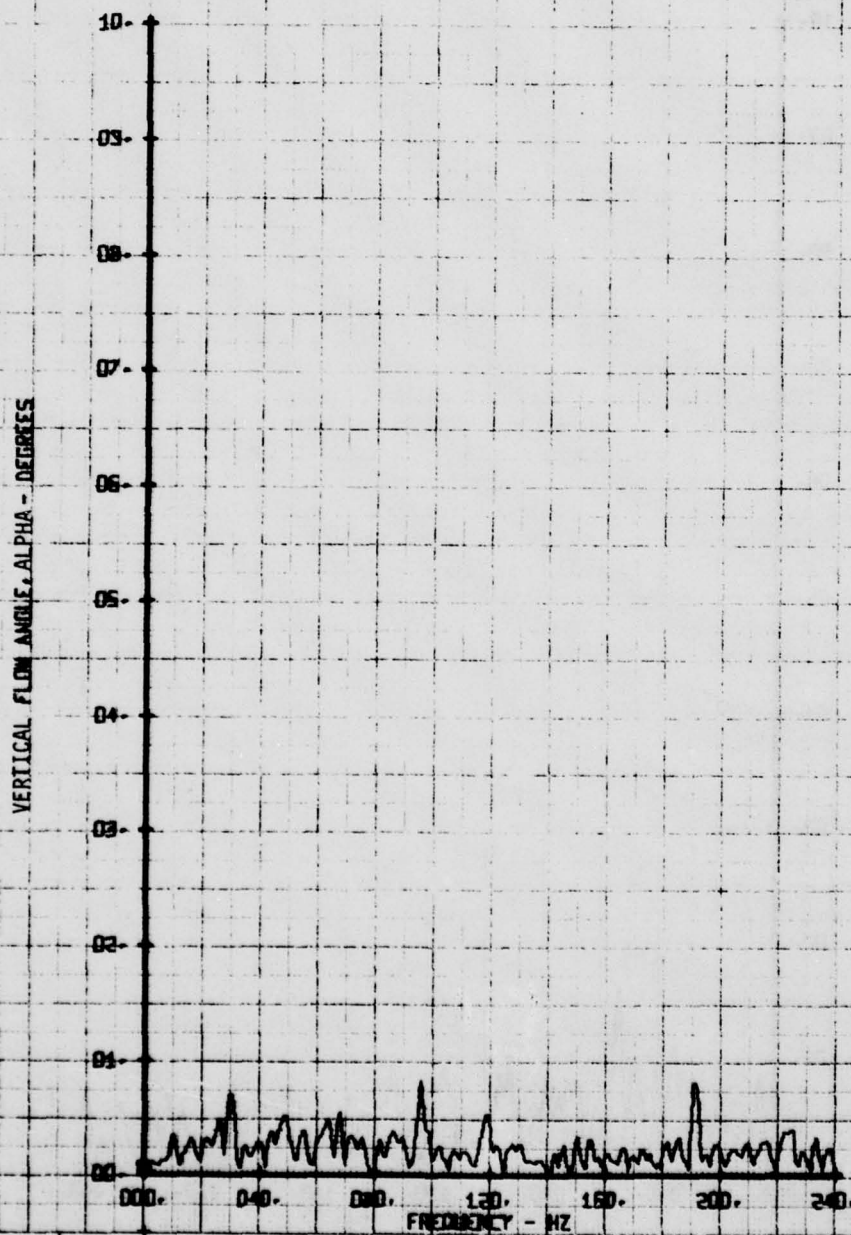
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 4

LEGEND
CH: PARAMETER
66 ALPHA



HDT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 5

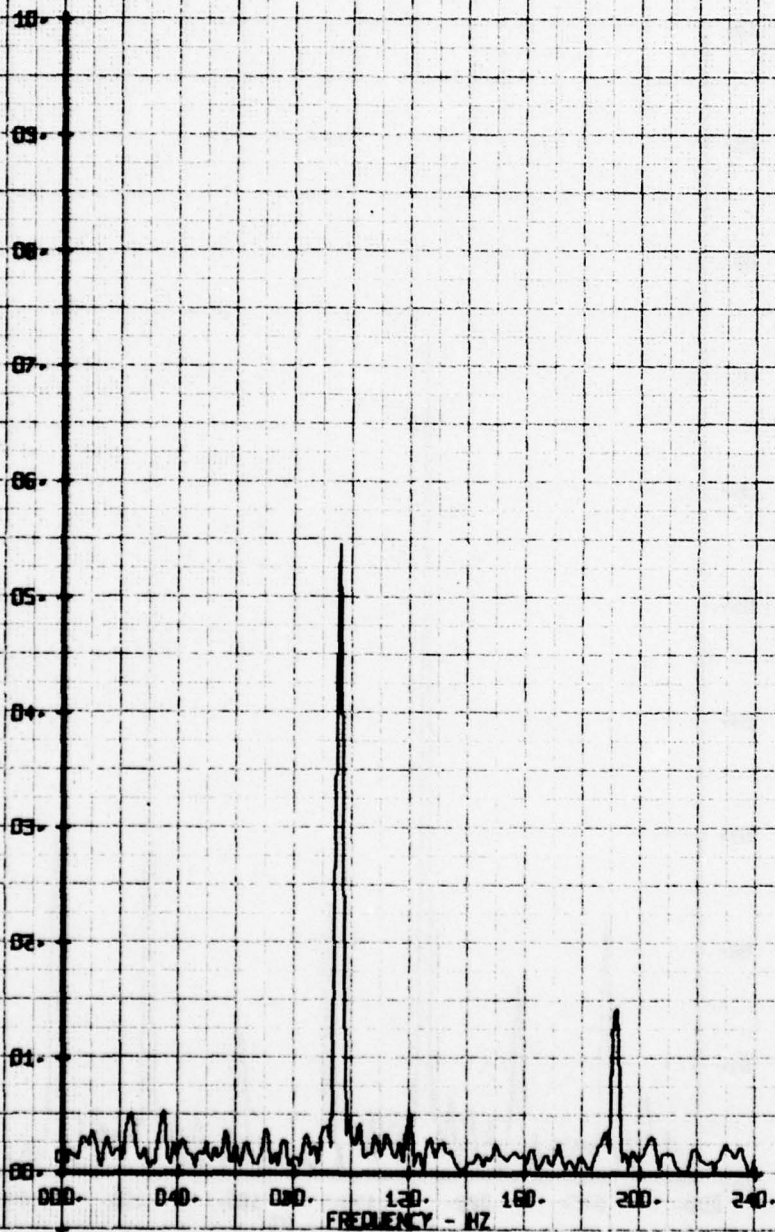
LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-NUM WITH STIFF PITCH ARMS
RUN 156 TP 6

LEGEND
CH 66
PARAMETER
ALPHA

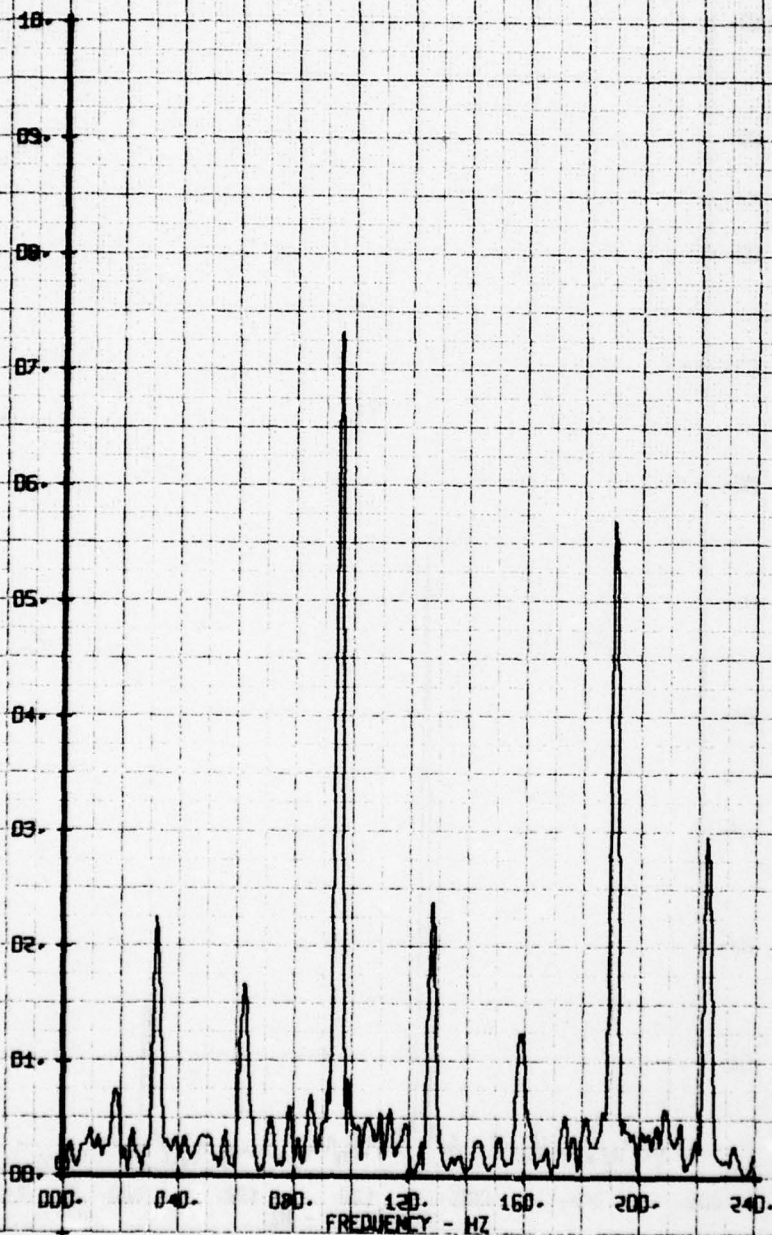
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 2

LEGEND
CH 66
PARAMETER
ALPHA

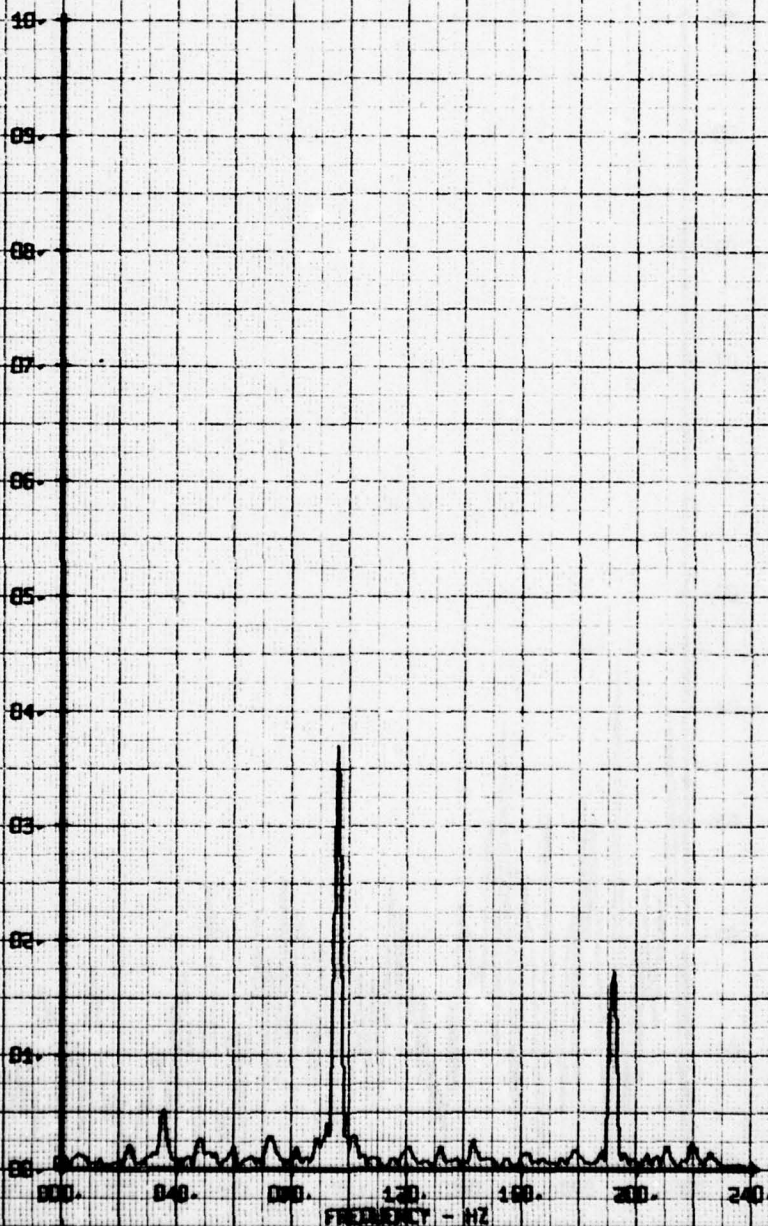
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 8

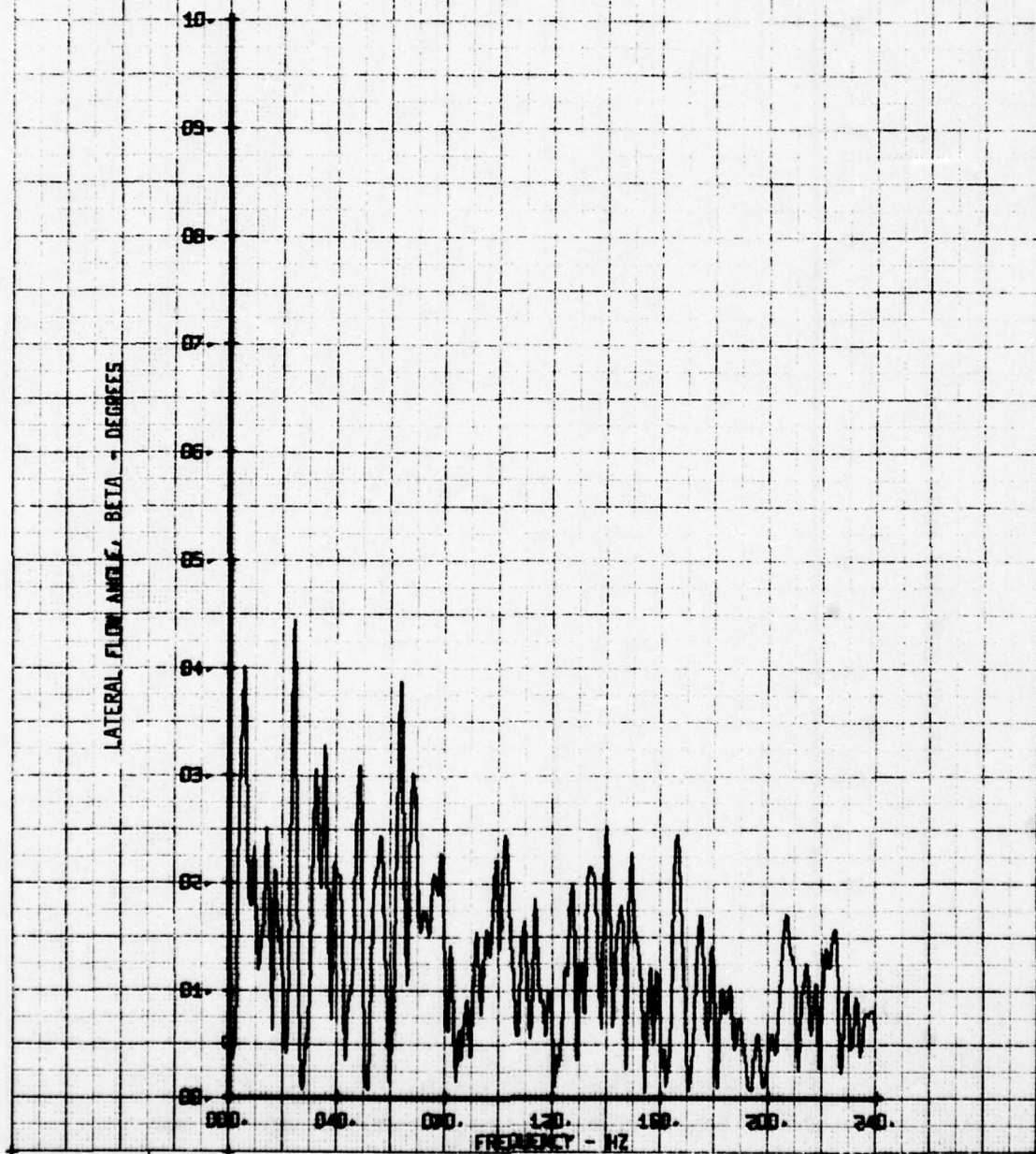
LEGEND
CH 66
PARAMETER
ALPHA

VERTICAL FILM ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-MUB WITH STIFF PITCH ARM
RUN 156 TP 2

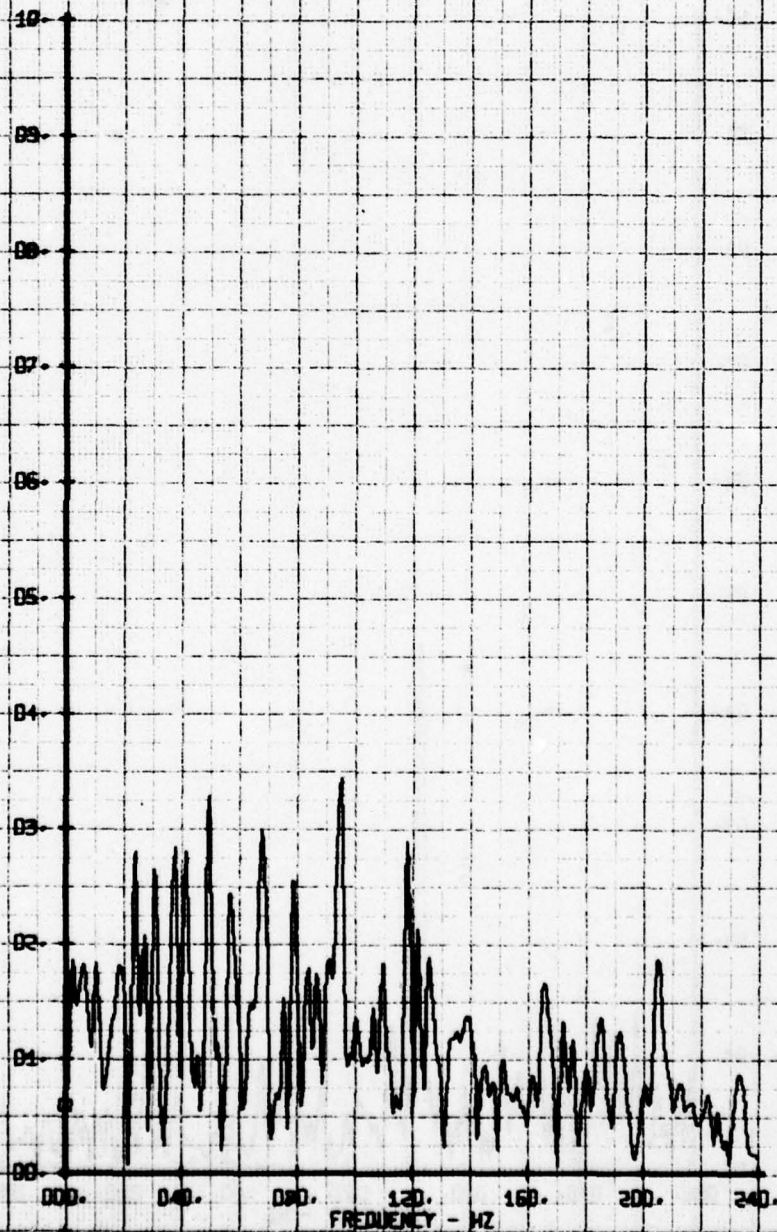
LEGEND
CH 65 PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 3

LEGEND
CH PARAMETER
65 BETA

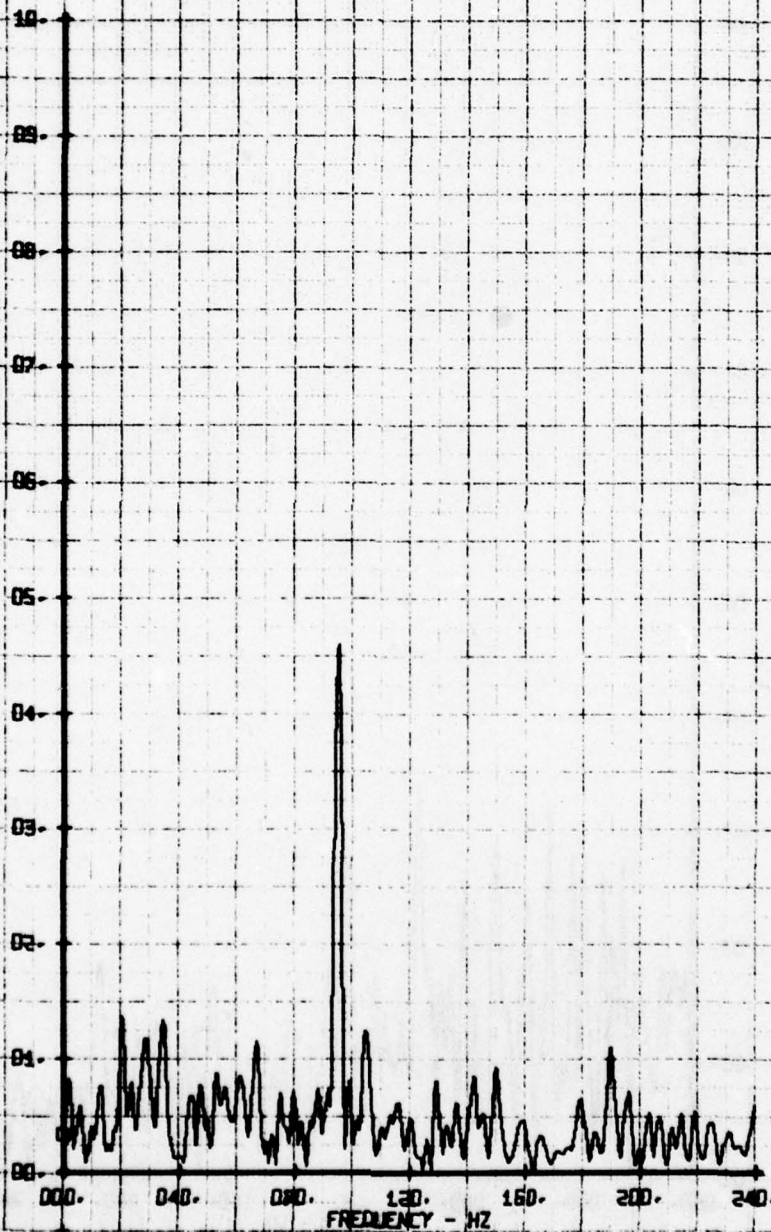
LATERAL FLOW ANGLE, BETA - DEGREES



NOT FILM WARE FREQUENCY ANALYSIS
BASELINE-NUM WITH STIFF PITCH ARMS
RUN 156 TP 4

LEGEND
CH 65
PARAMETER
BETA

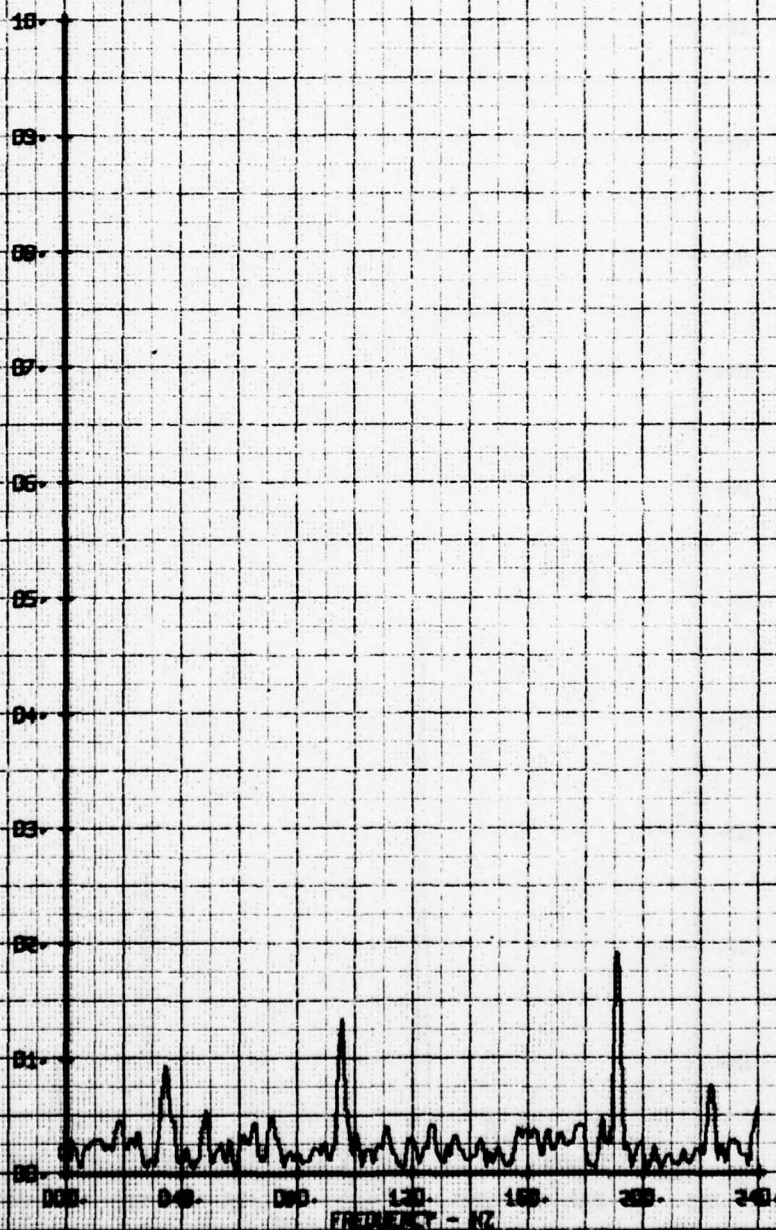
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 5

LEGEND
CH PARAMETER
65 BETA

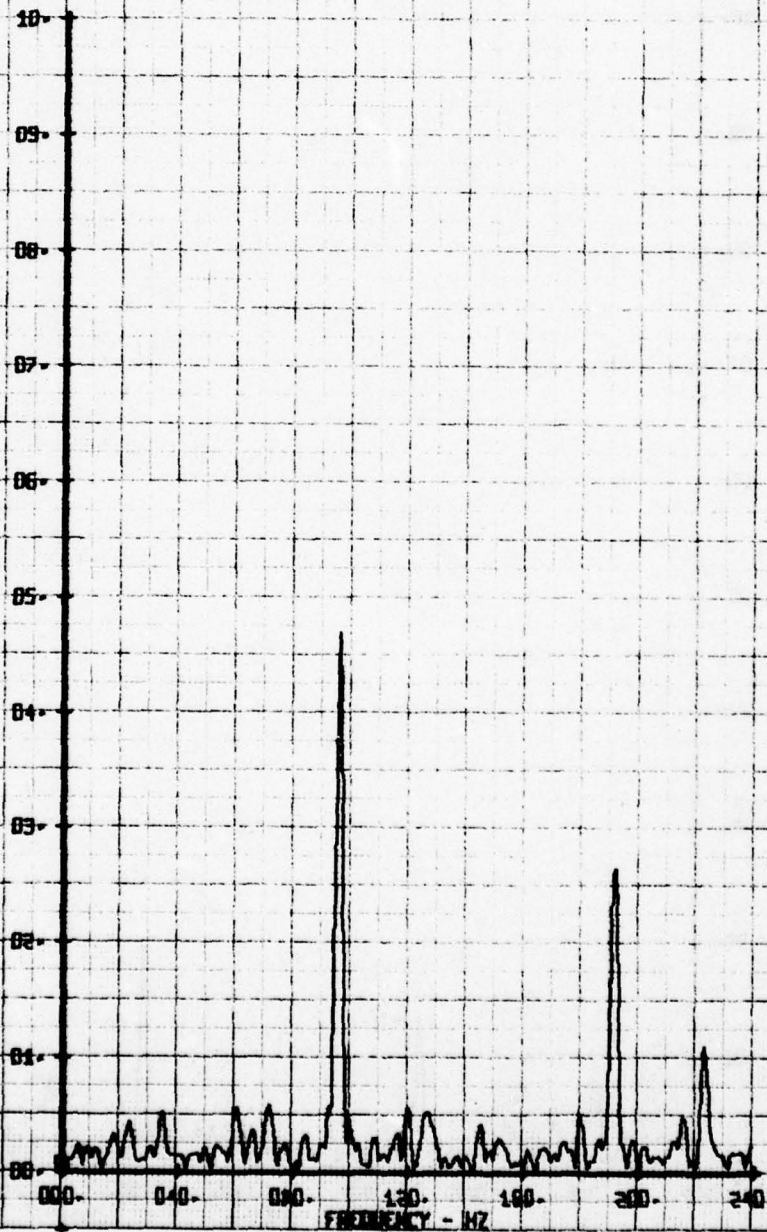
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 6

LEGEND
CH: PARAMETER
65: BETA

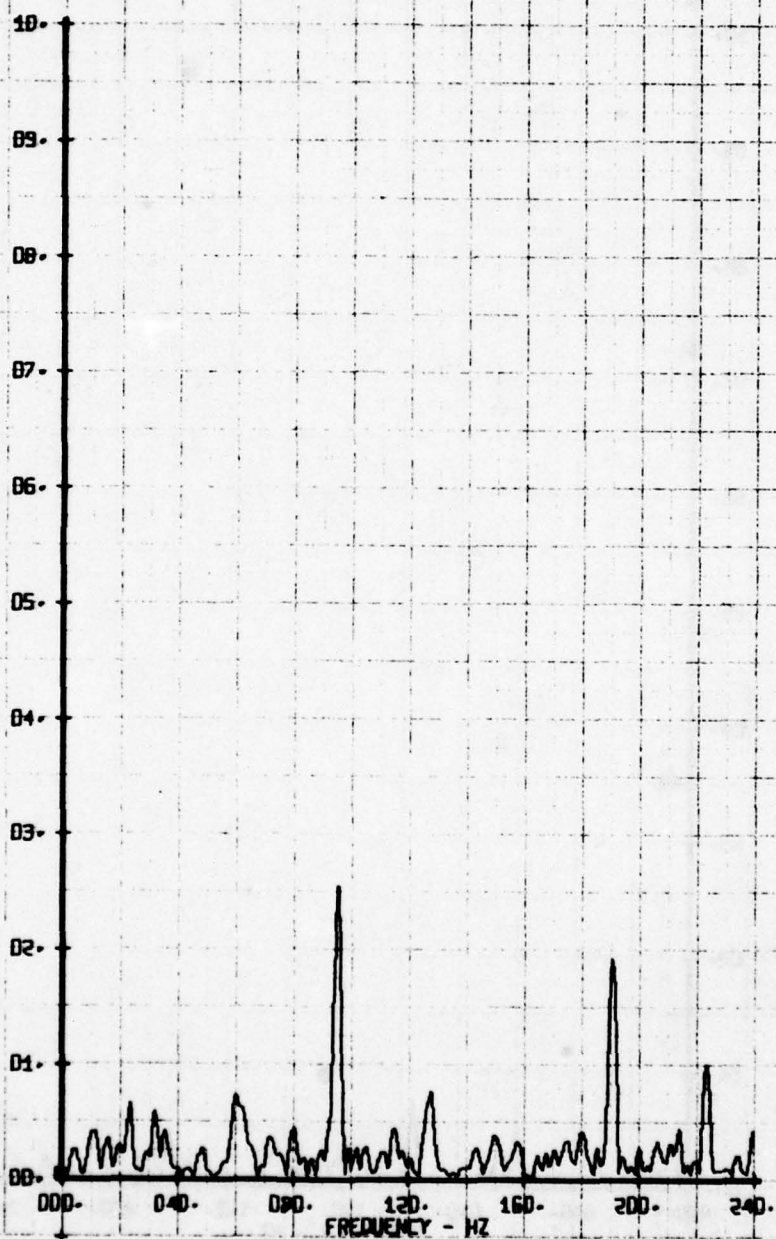
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 7

LEGEND
CH 65
PARAMETER
BETA

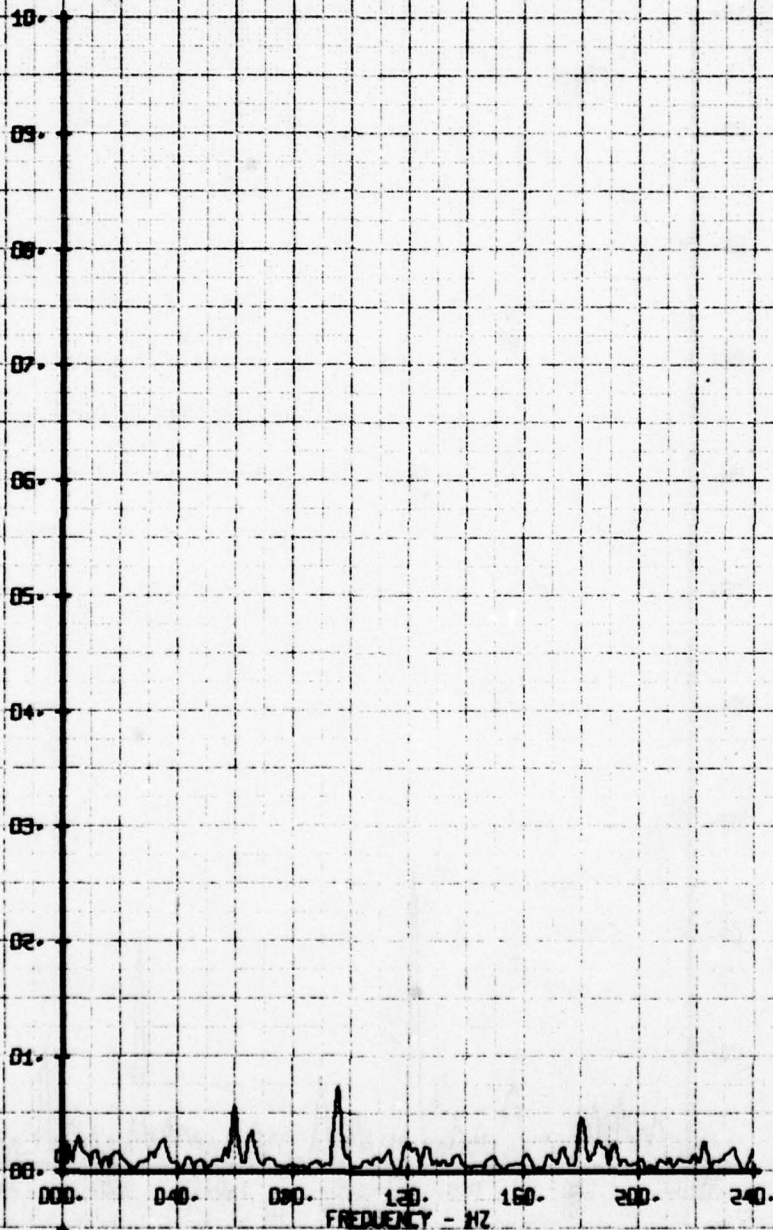
LATERAL FLOW ANGLE, BETA - DEGREES



NOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-HUM WITH STIFF PITCH ARMS
RUN 156 TP 8

LEGEND
CH 65
PARAMETER
BETA

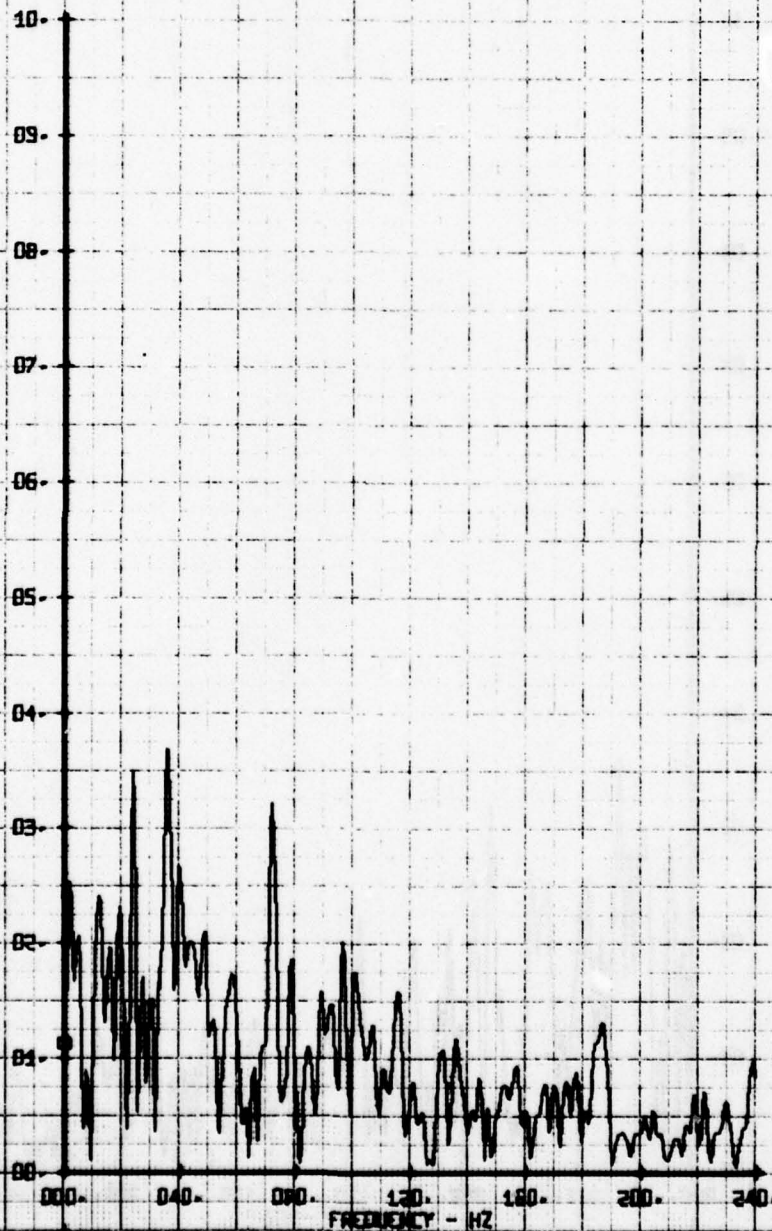
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 2

LEGEND
CH 66 PARAMETER
V-ALPHA

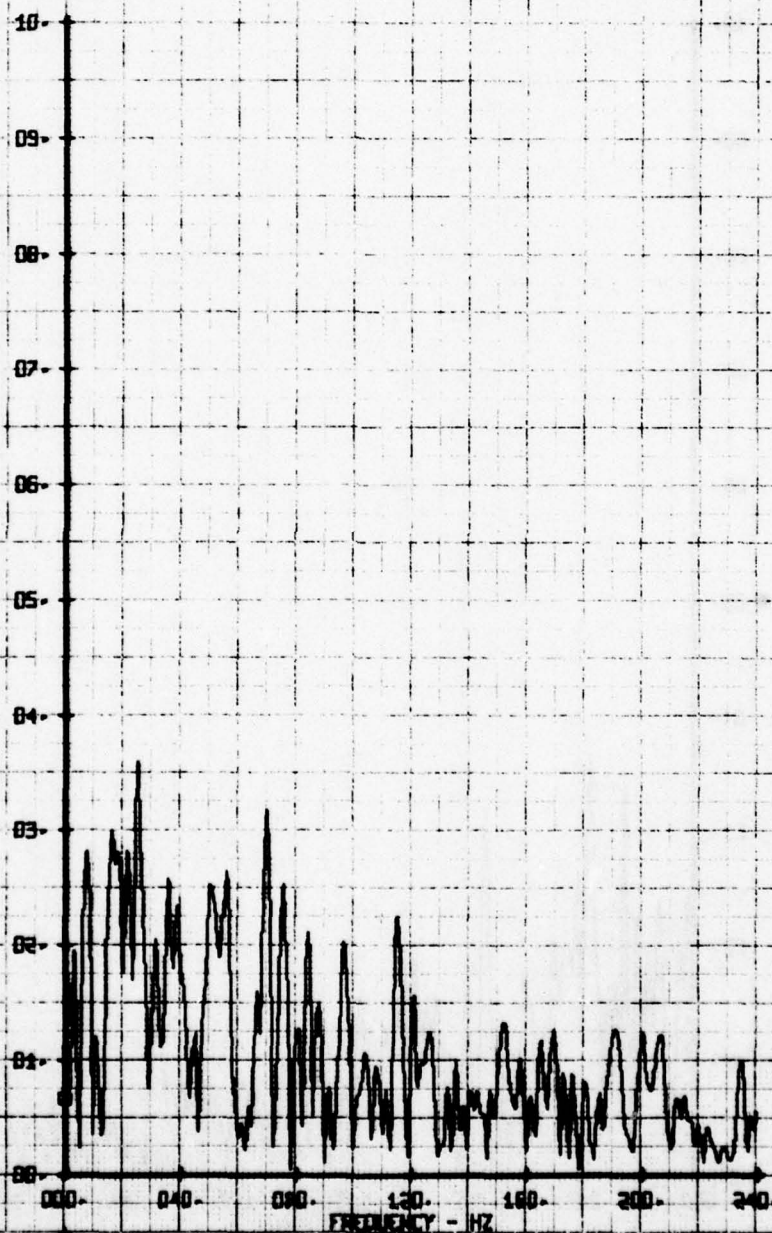
X-Y VELOCITY COMPONENT V-ALPHA



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 3

LEGEND
CH 66 PARAMETER
V-ALPHA

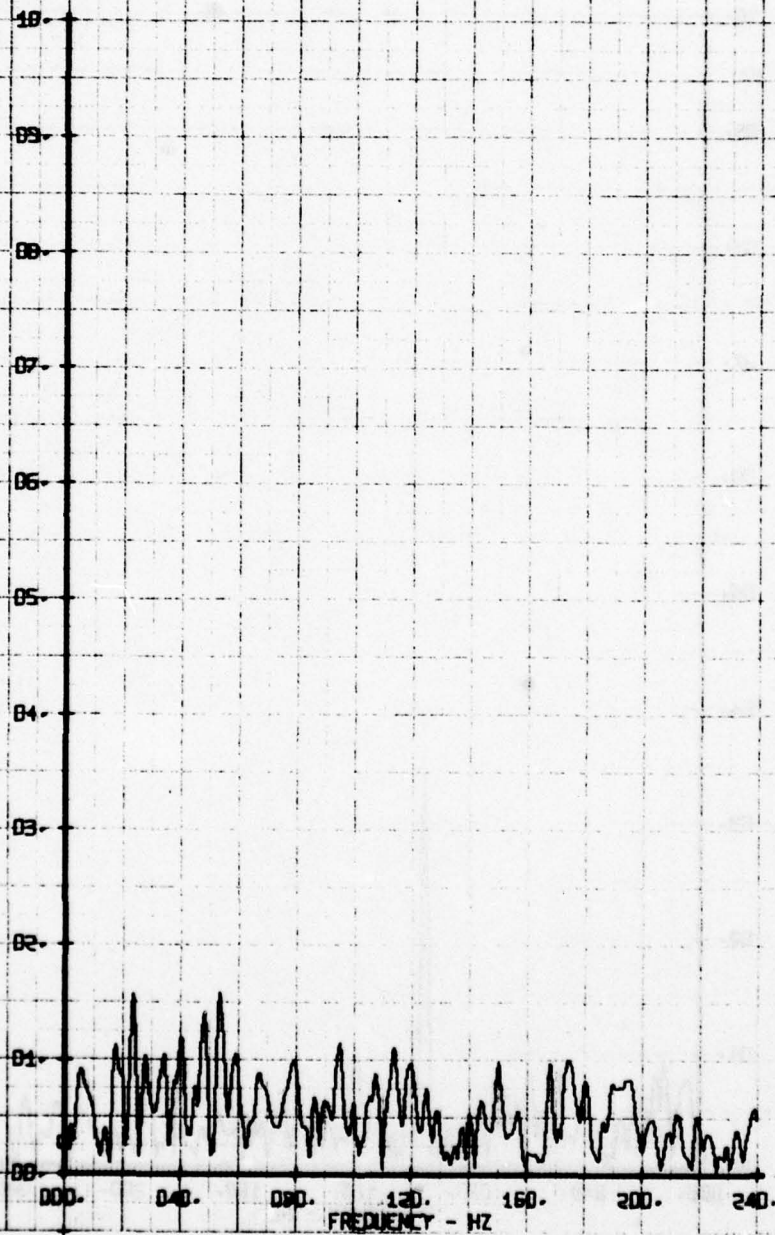
X-Y VELOCITY COMPONENT V-ALPHA/FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 155 TP 4

LEGEND
CH 66
PARAMETER
V-ALPHA

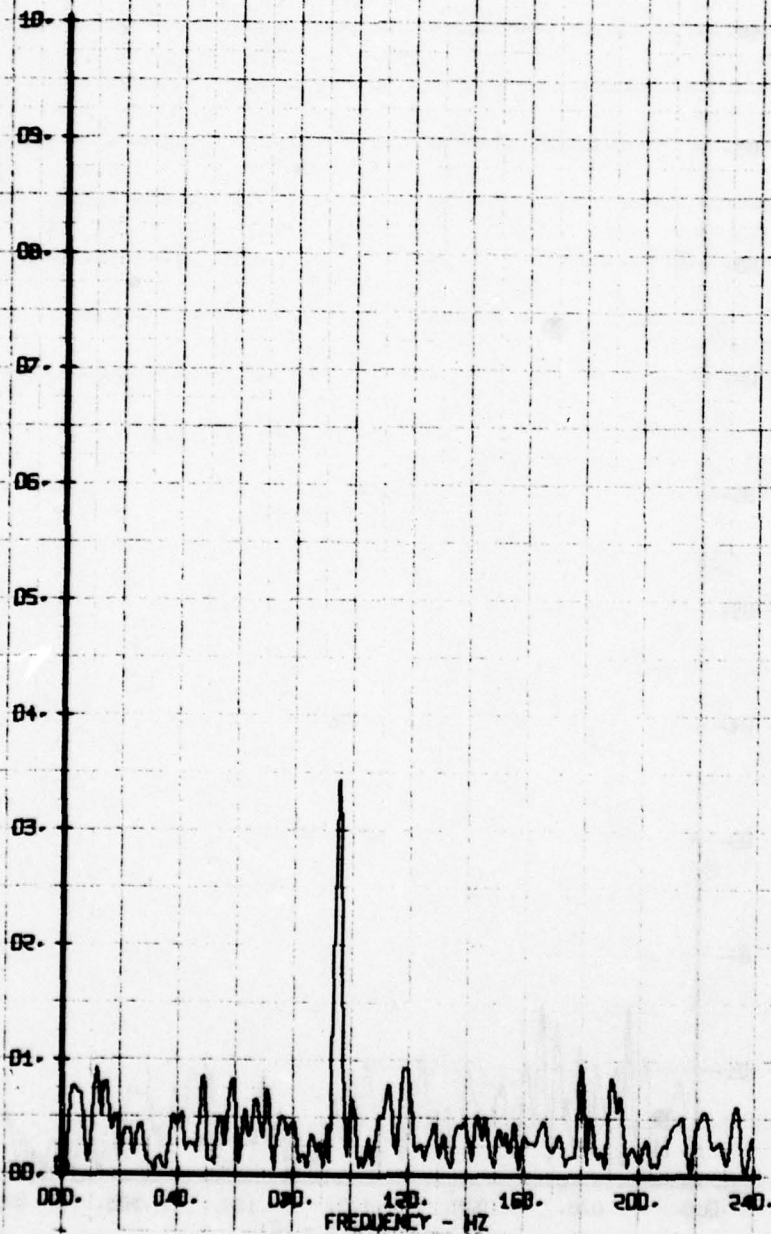
X-Y VELOCITY COMPONENT V-ALPHA.FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-RUN WITH STIFF PITCH ARMS
RUN 156 TP. 5

LEGEND
CH 66
PARAMETER
V-ALPHA

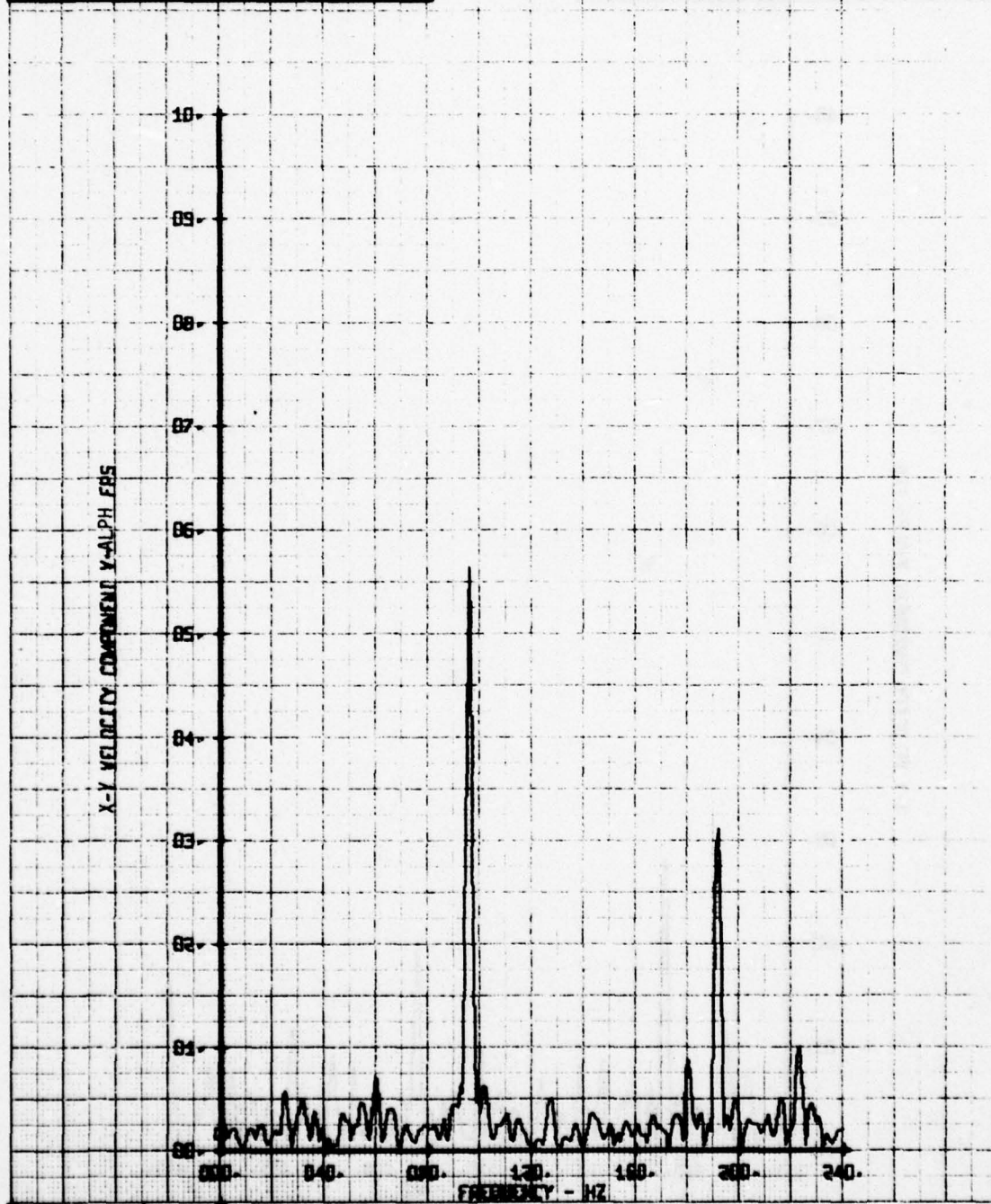
X-Y VELOCITY COMPONENT V-ALPHA FPS



FREQUENCY - HZ

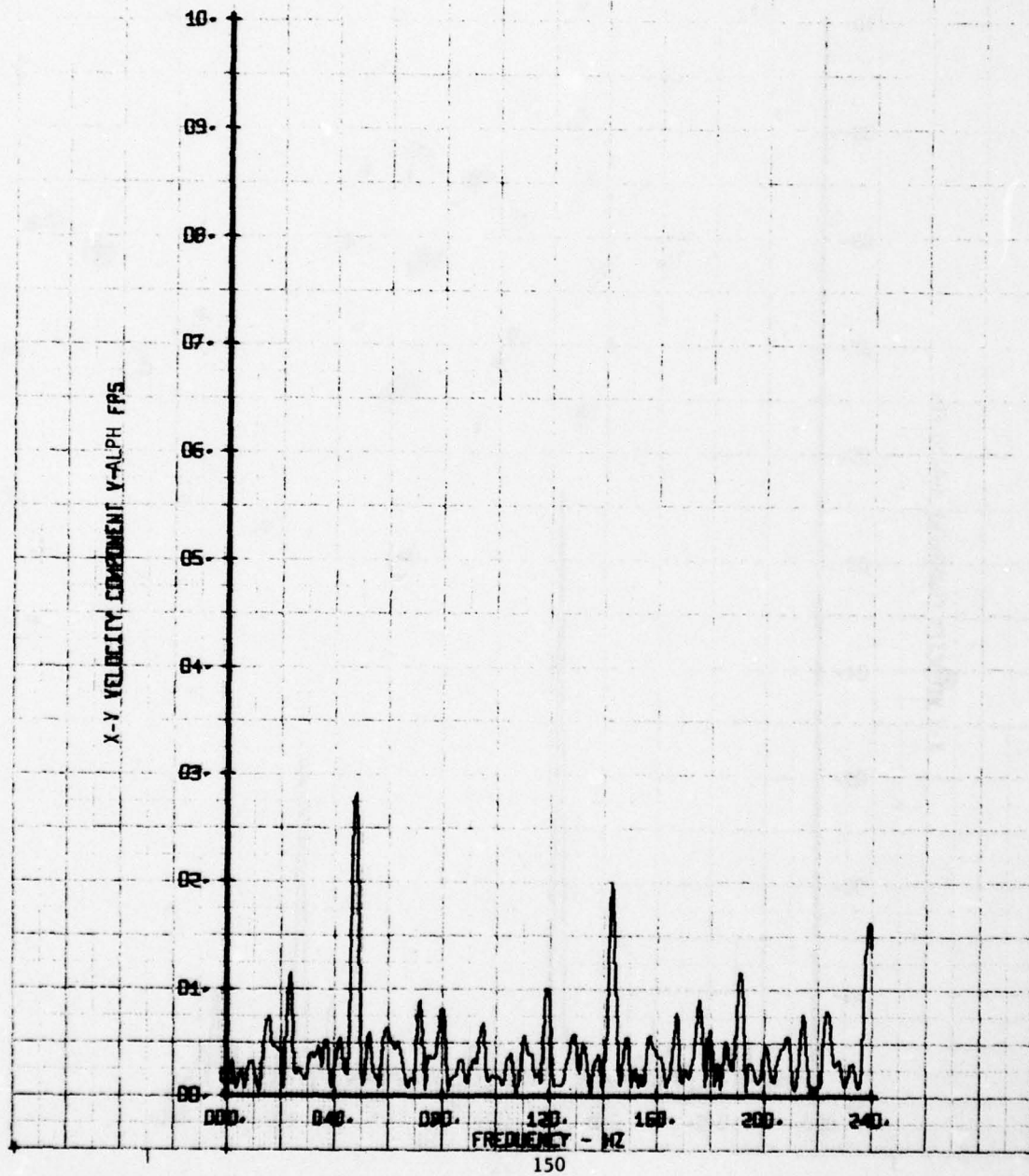
HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-HUM WITH STIFF PITCH ARMS
RUN 156 TP 6

LEGEND
CH: PARAMETER
66: V-ALPHA



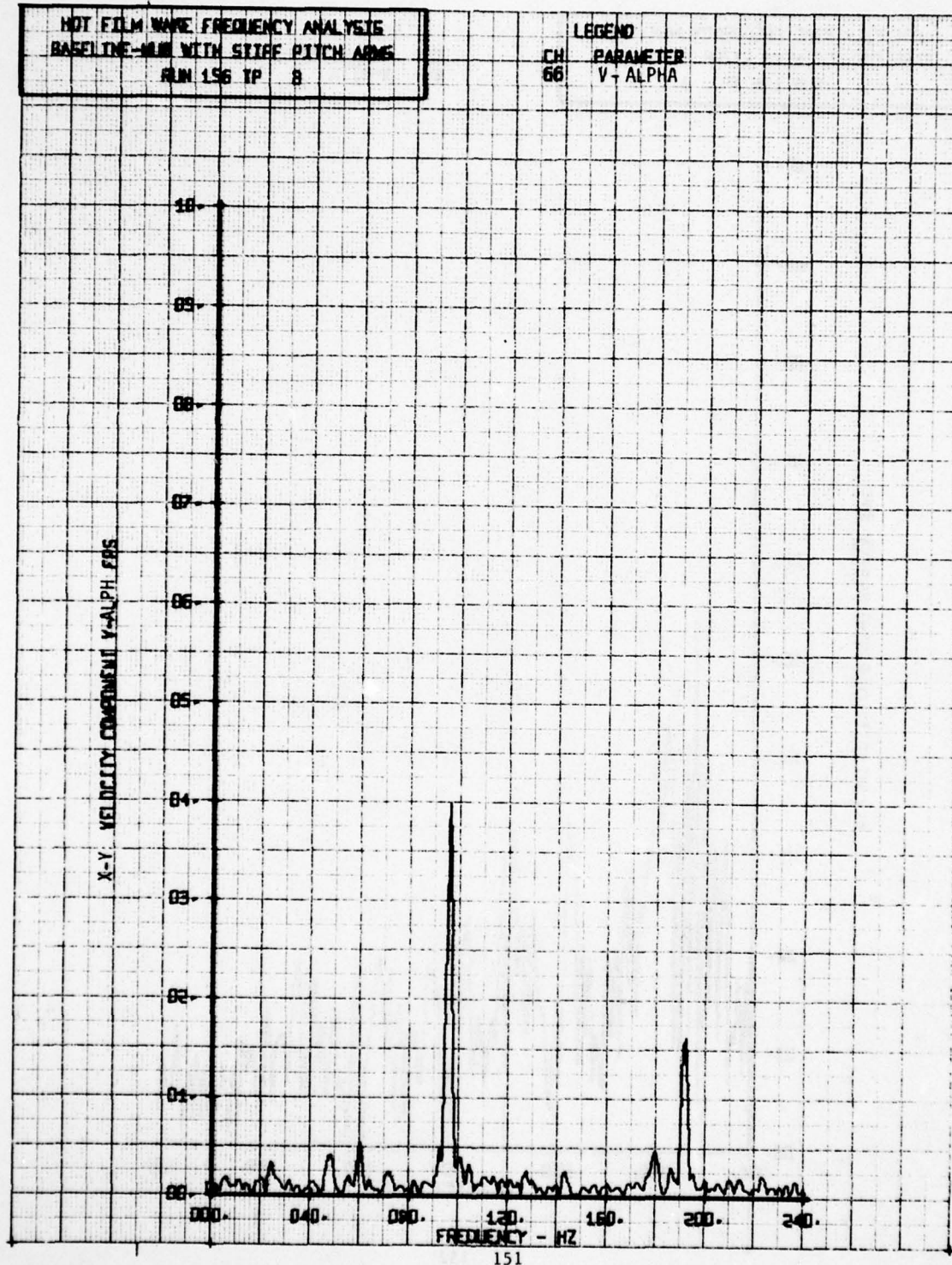
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 7

LEGEND
CH. 66
PARAMETER
V-ALPHA



NOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-MMM WITH STIFF PITCH ARMS
RUN 156 TP 8

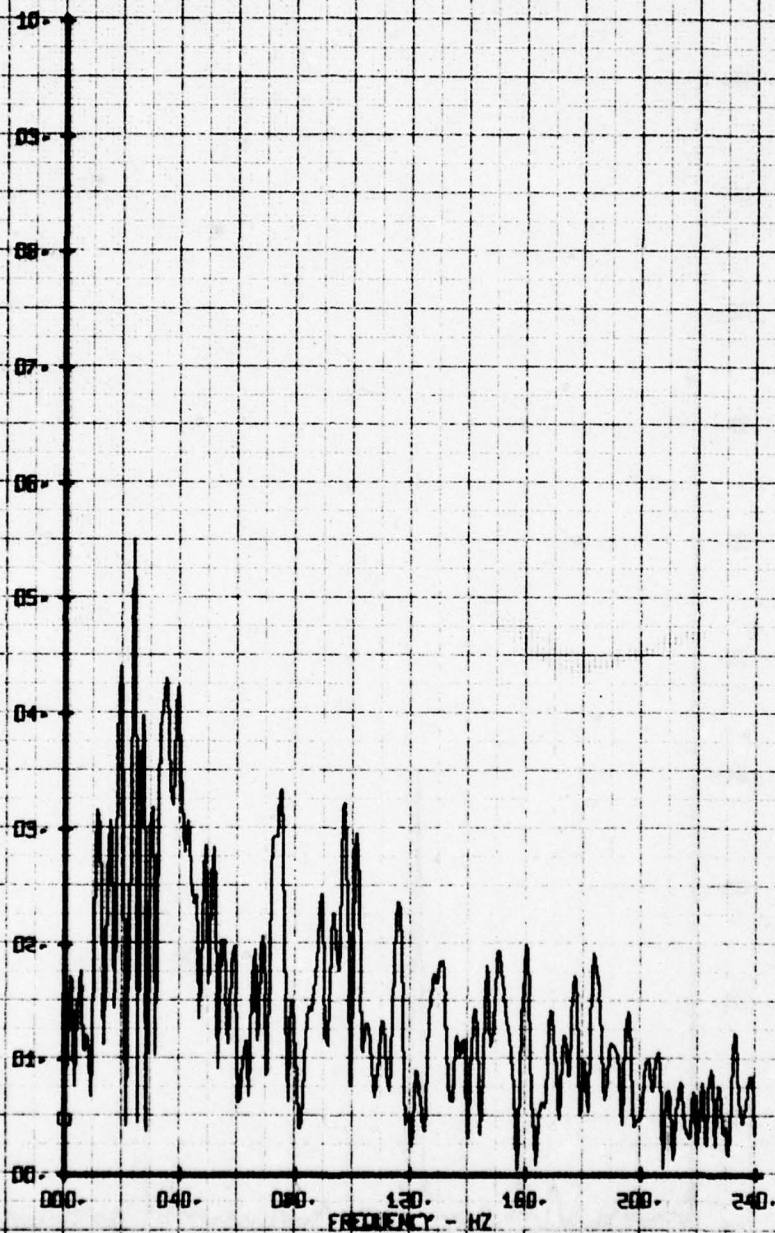
LEGEND
CH 66
PARAMETER
V-ALPHA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-NUB WITH STIFF PITCH ARMS
RUN 156 TP 2

LEGEND
CH 65
PARAMETER
V-BETA

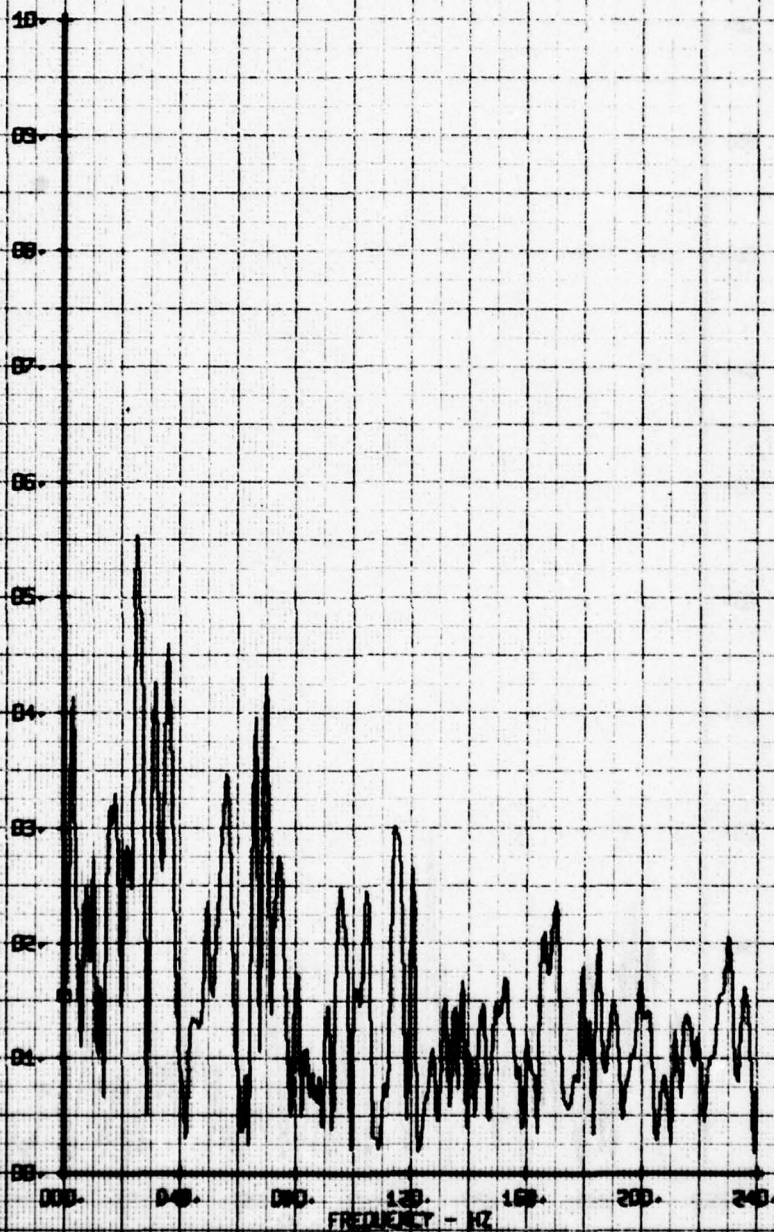
A-7 VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUM WITH STIFF PITCH ARMS
RUN 156 TP 3

LEGEND
CH. 65 PARAMETER
V-BETA

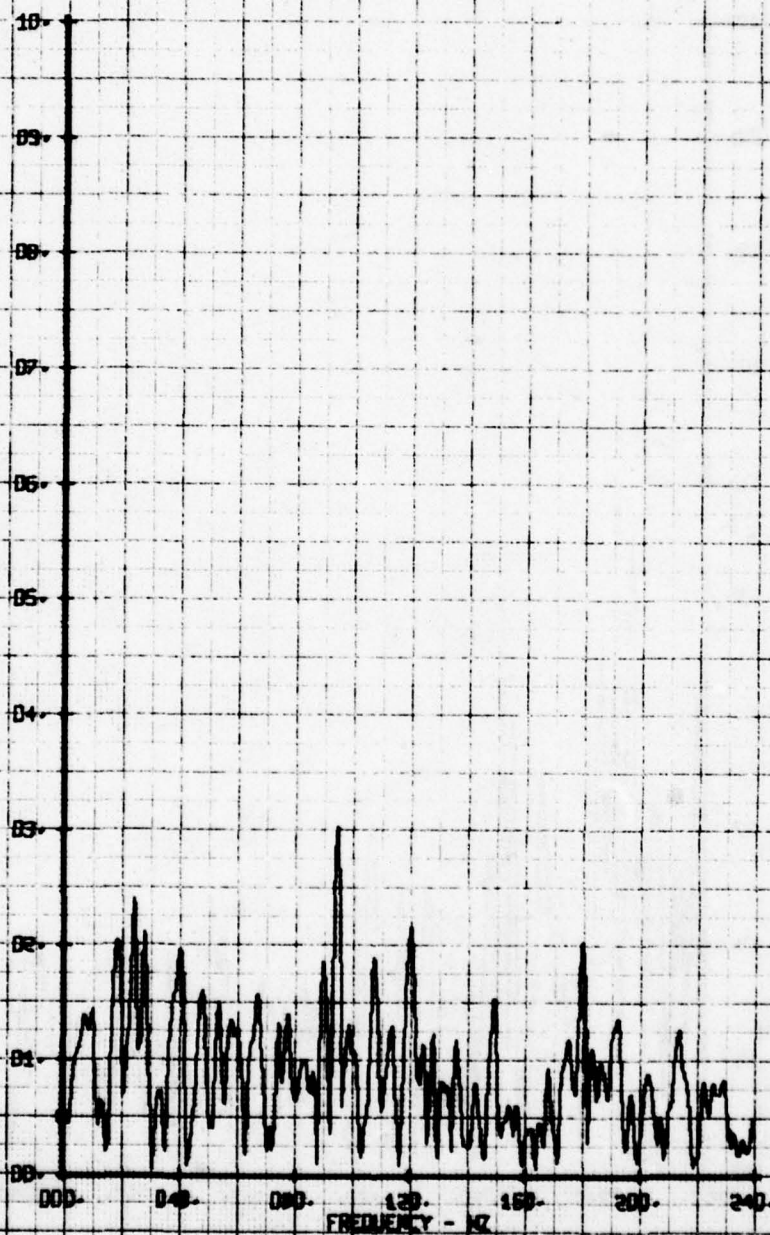
A-Z VELOCITY COMPONENT V-BETA .FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 4

LEGEND
CH 65 PARAMETER
V-BETA

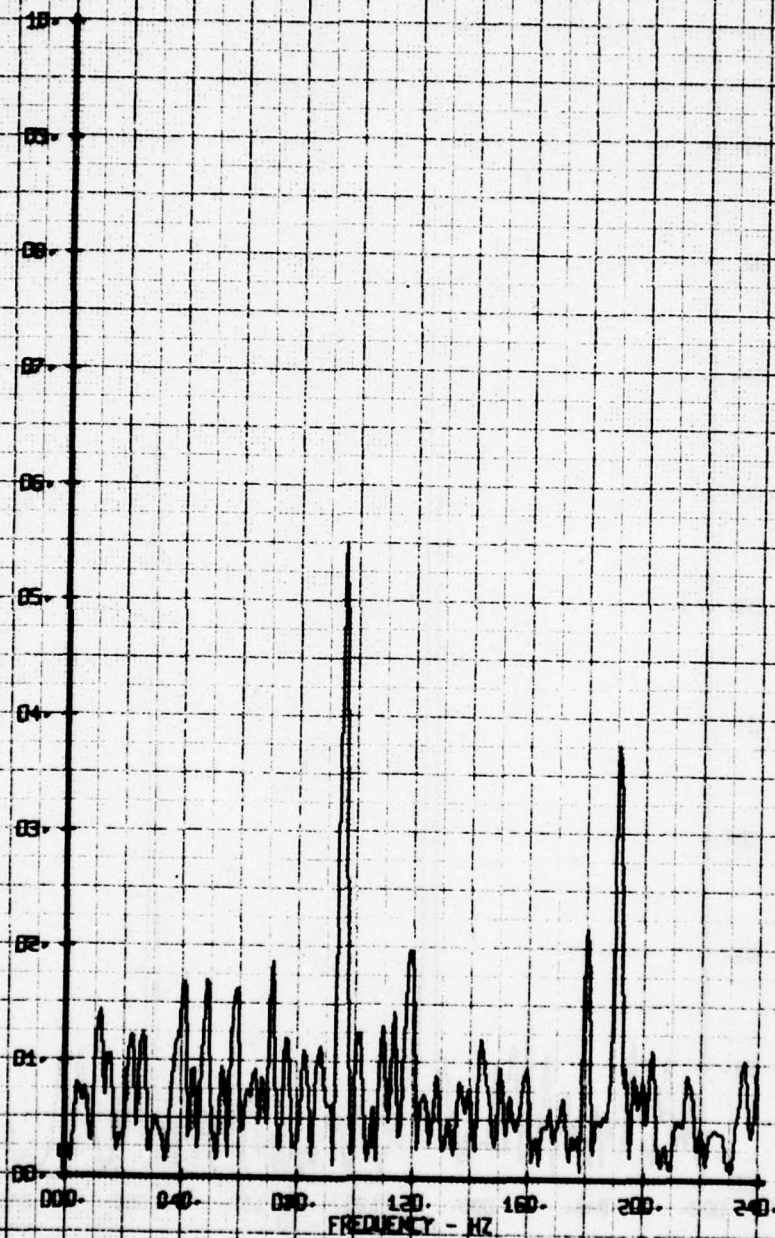
R-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE-HIGH WITH STIFF PITCH ARM
RUN 155 TP 5

LEGEND
CH 65
PARAMETER
V-BETA

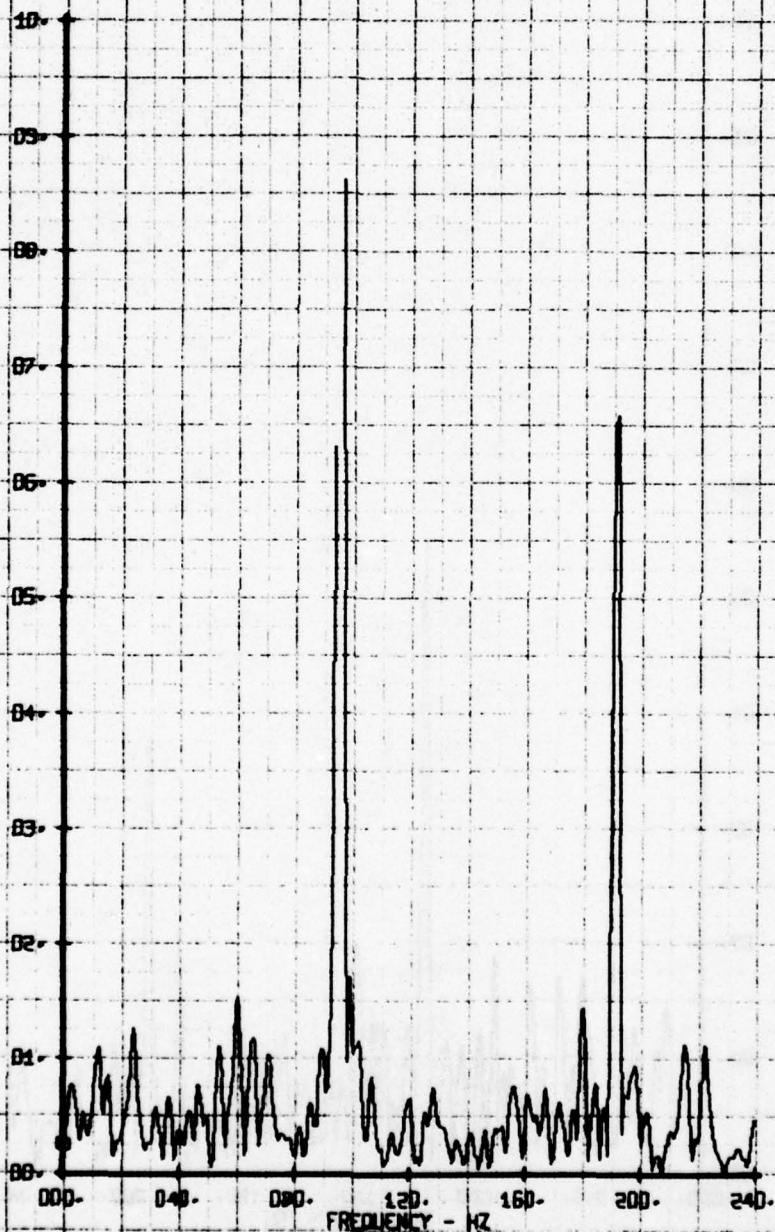
X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 6

LEGEND
CH 65
PARAMETER
V-BETA

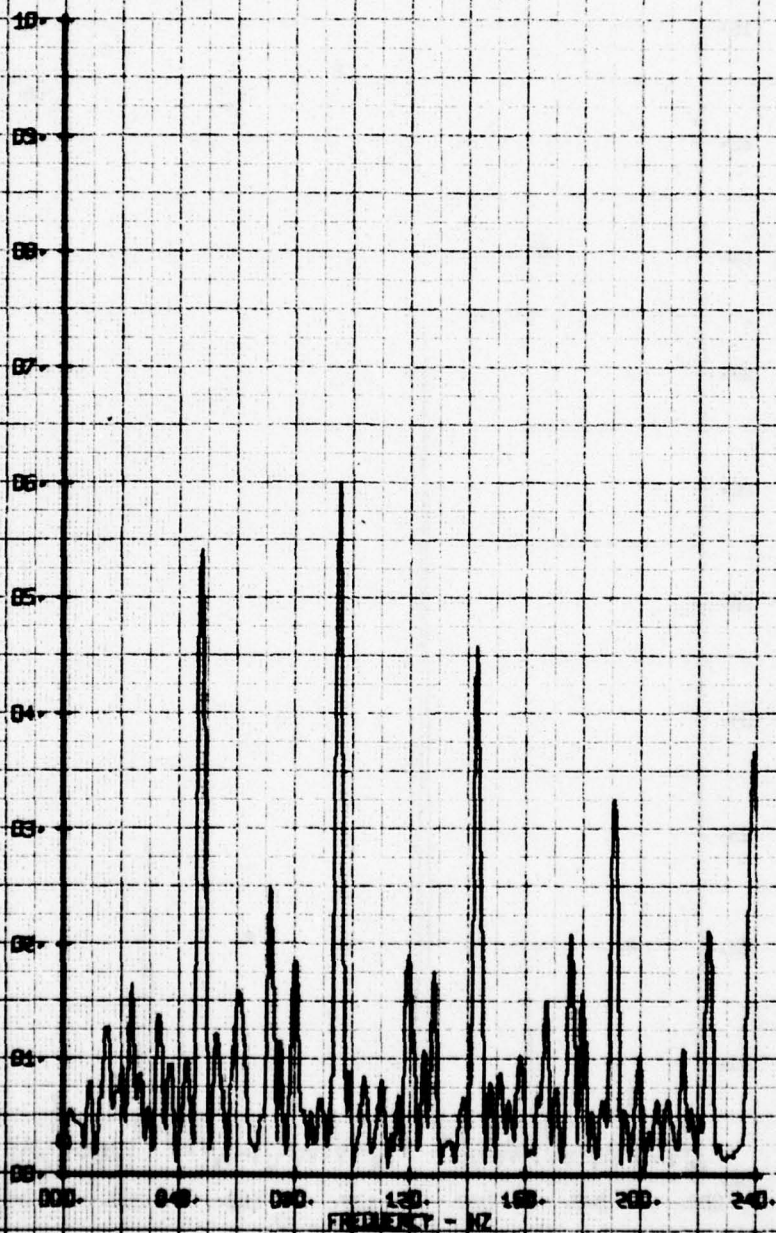
K-7 VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 2

LEGEND
CH 65
PARAMETER
V-BETA

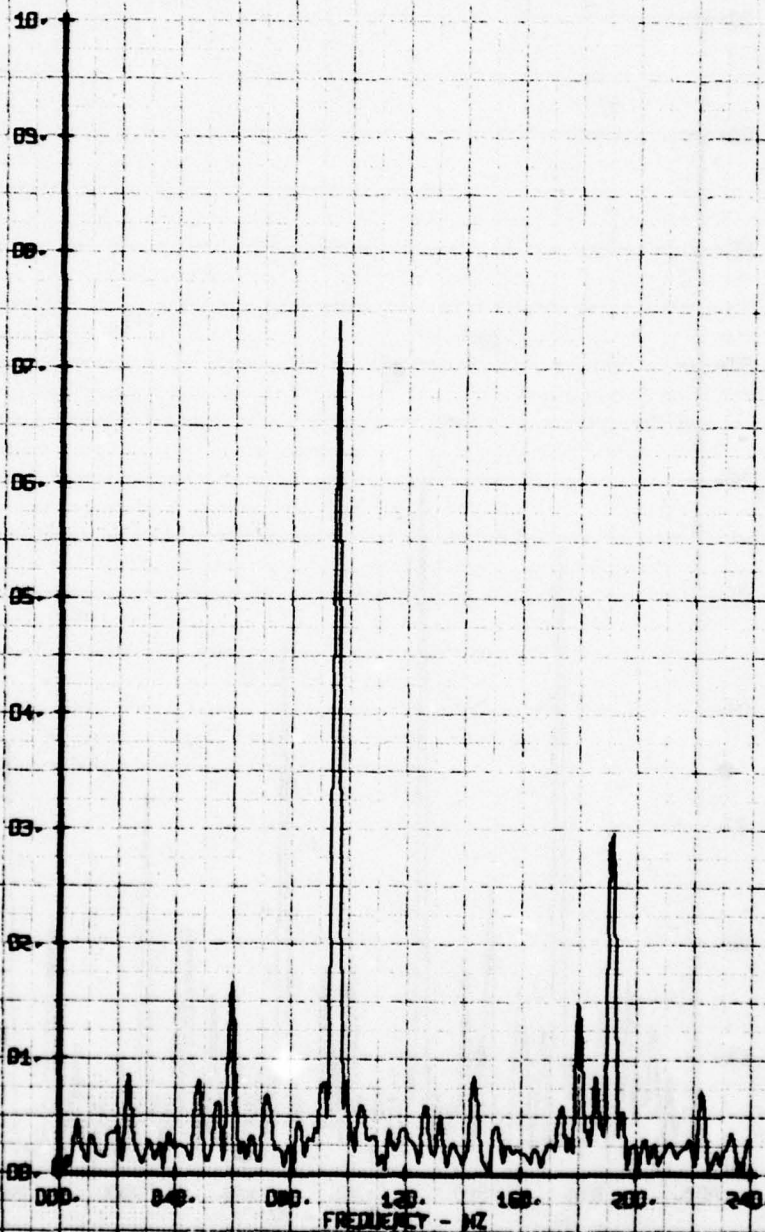
A-7 VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE-HUB WITH STIFF PITCH ARMS
RUN 156 TP 8

LEGEND
CH 65 PARAMETER
V-BETA

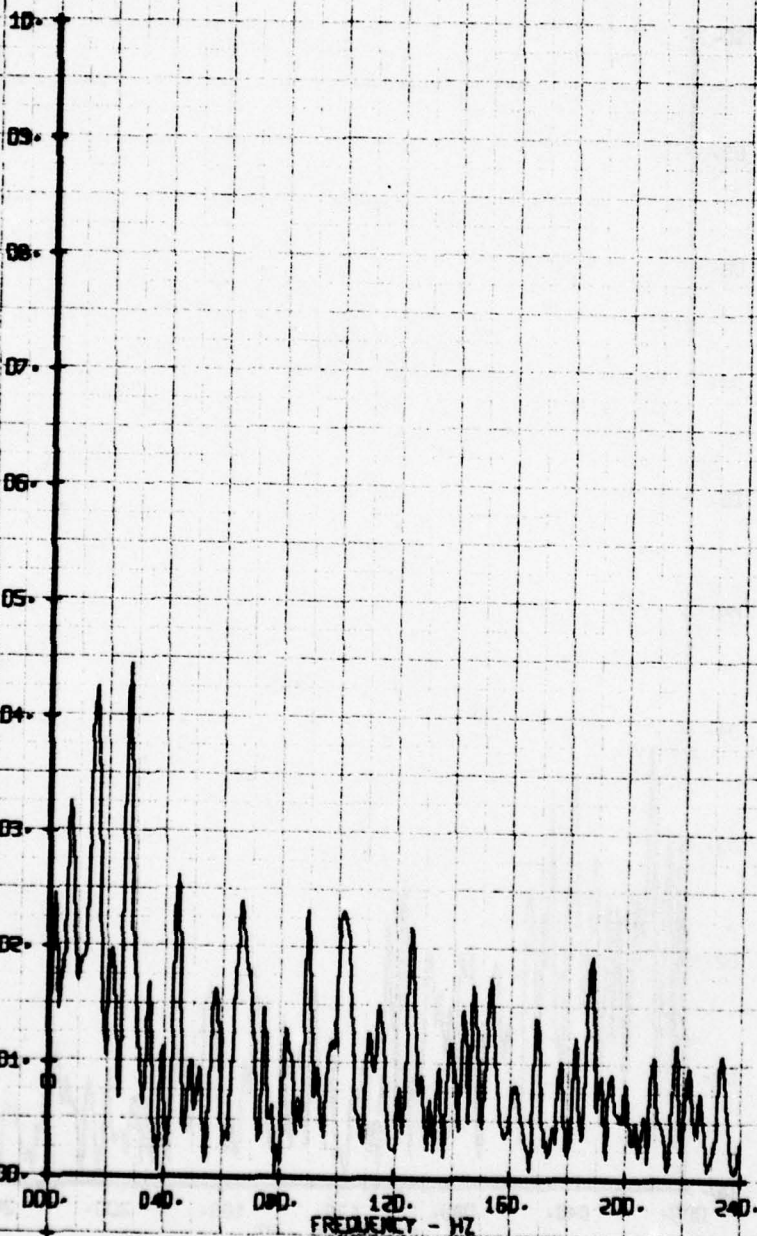
A-Z VELOCITY COMPONENT V-BETA .PPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT. HUB
RUN 158 TP 2

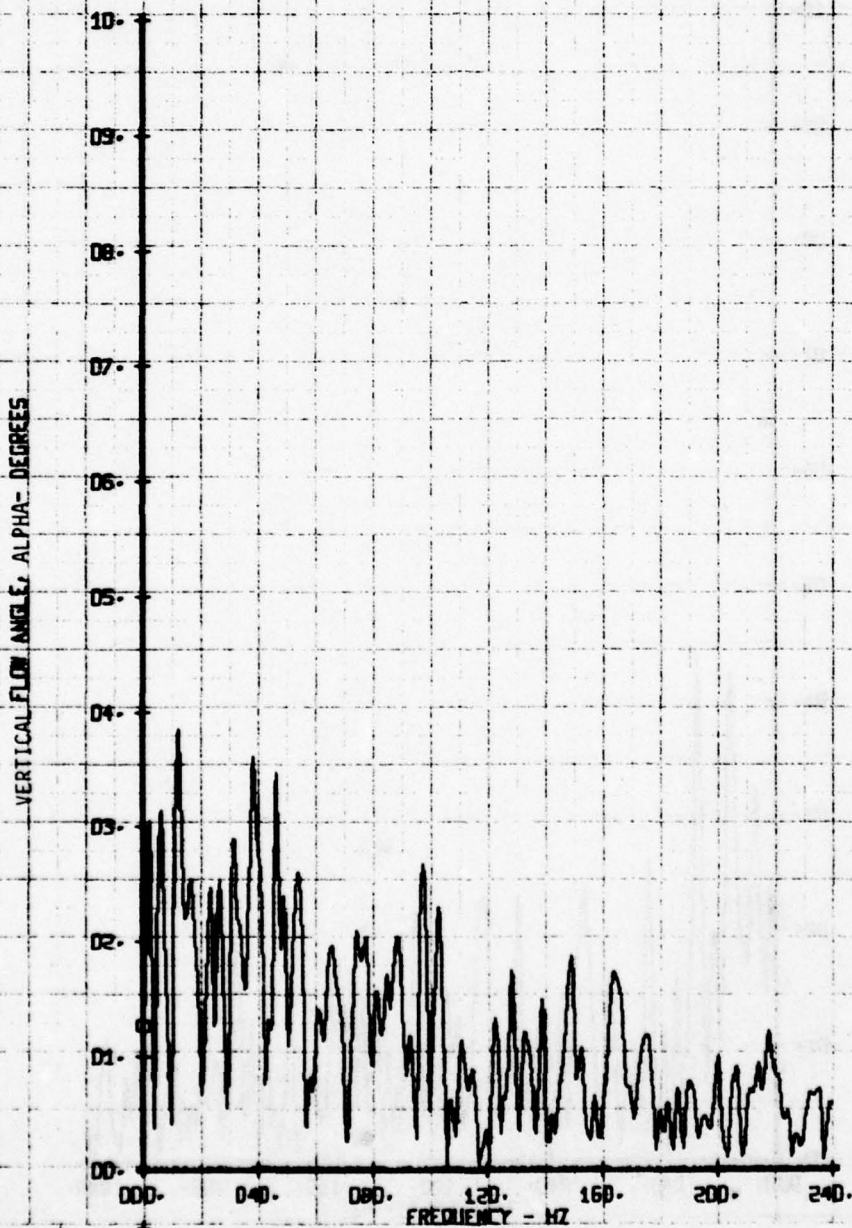
LEGEND
CH 66
PARAMETER
ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



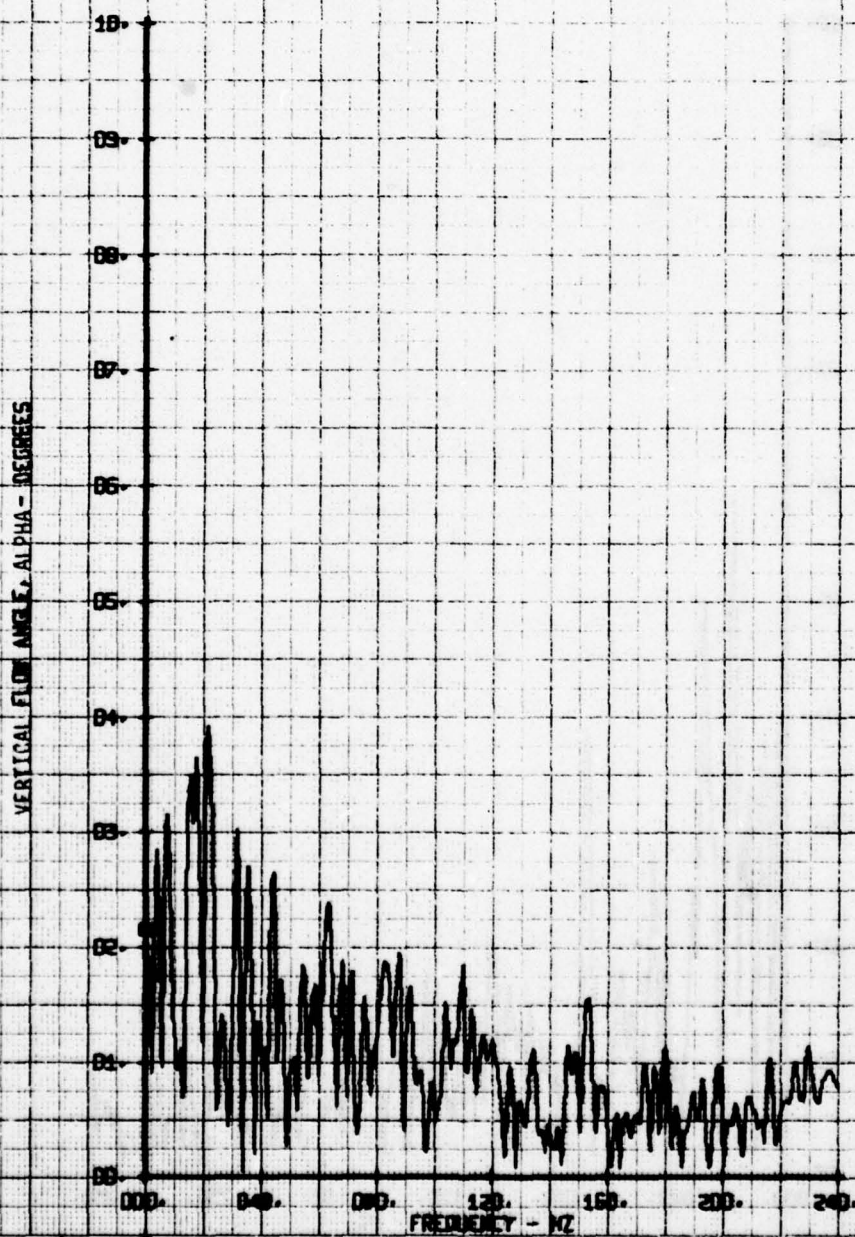
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U BLADES OFF-NON-ROT-HUB
RUN 159 TP 3

LEGEND
EH
66
PARAMETER
ALPHA



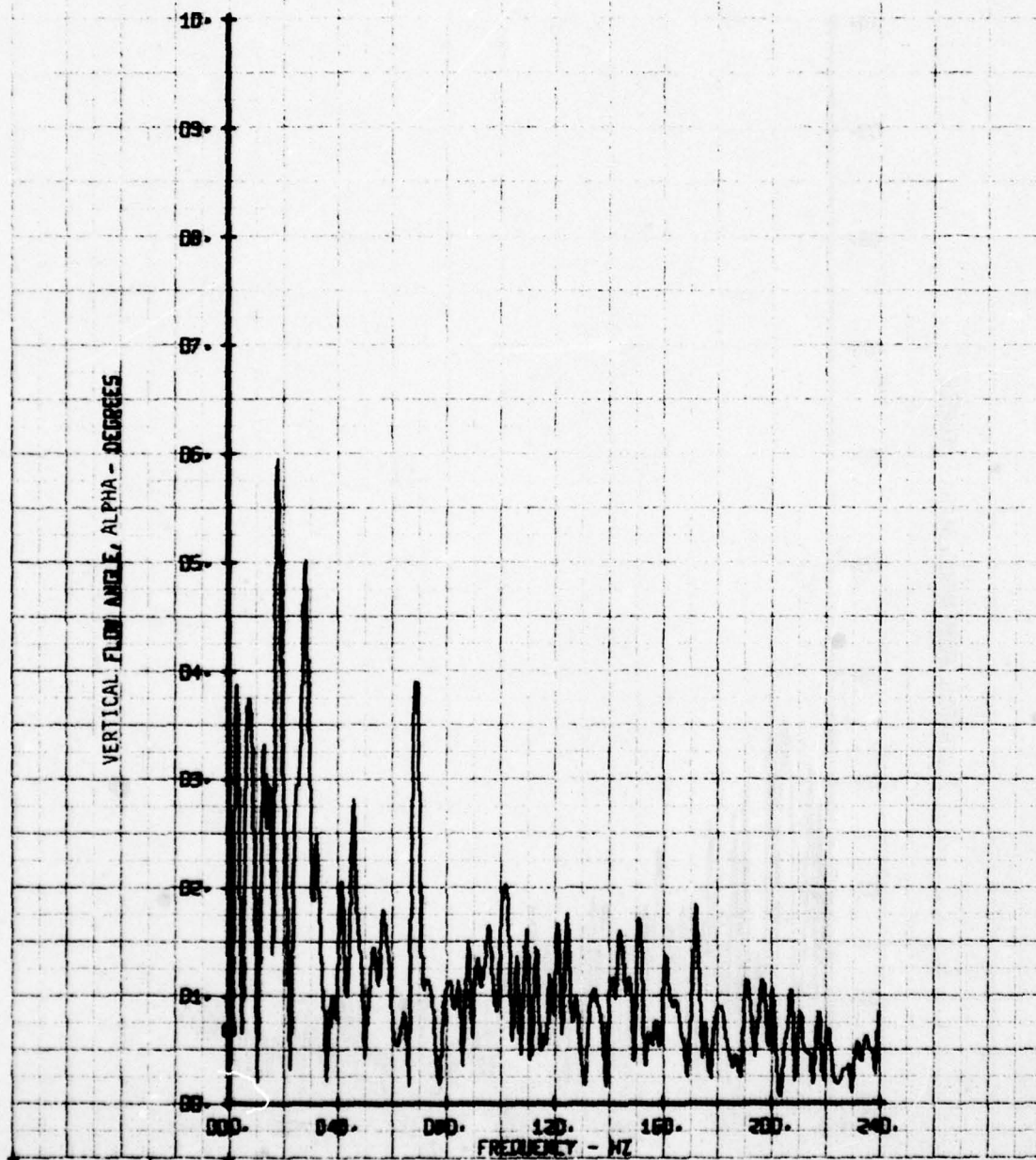
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 4

LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT. HUB
RUN 158 TP 5

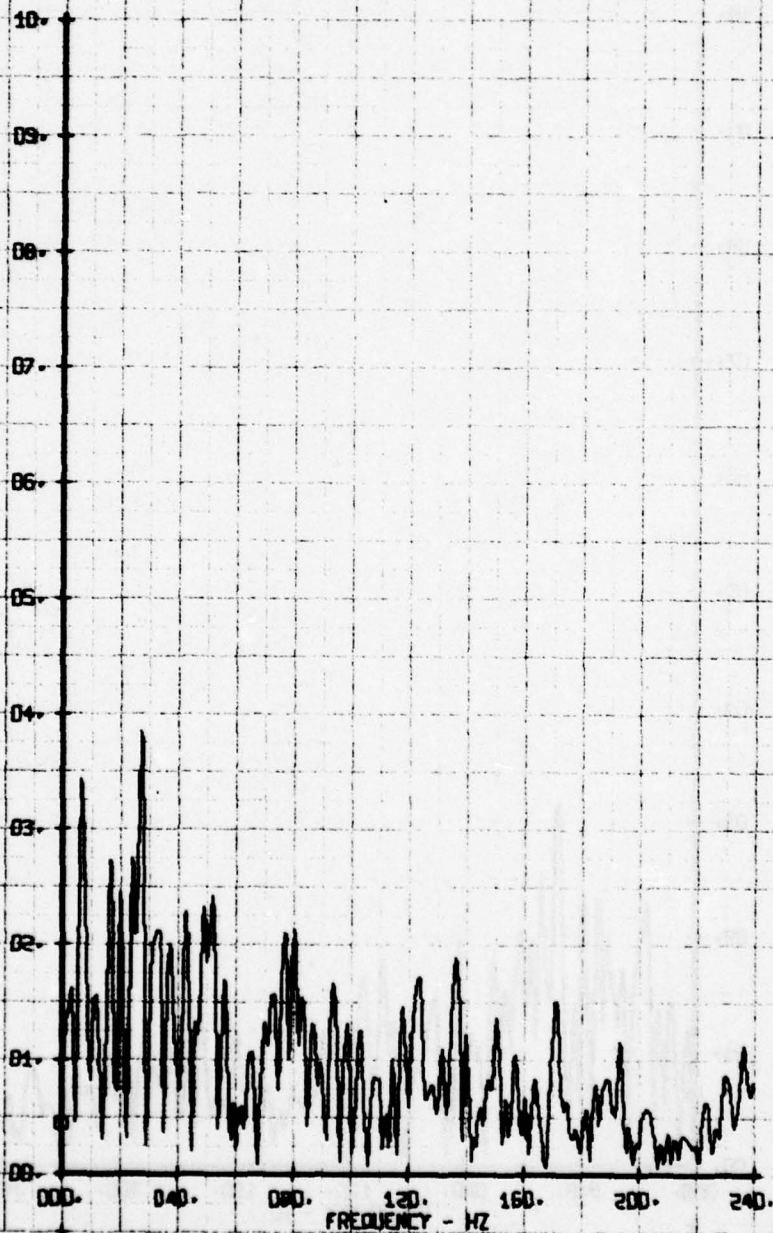
LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF-NON-ROT. HUB
RUN 159 TP 5

LEGEND
CN: PARAMETER
56: ALPHA

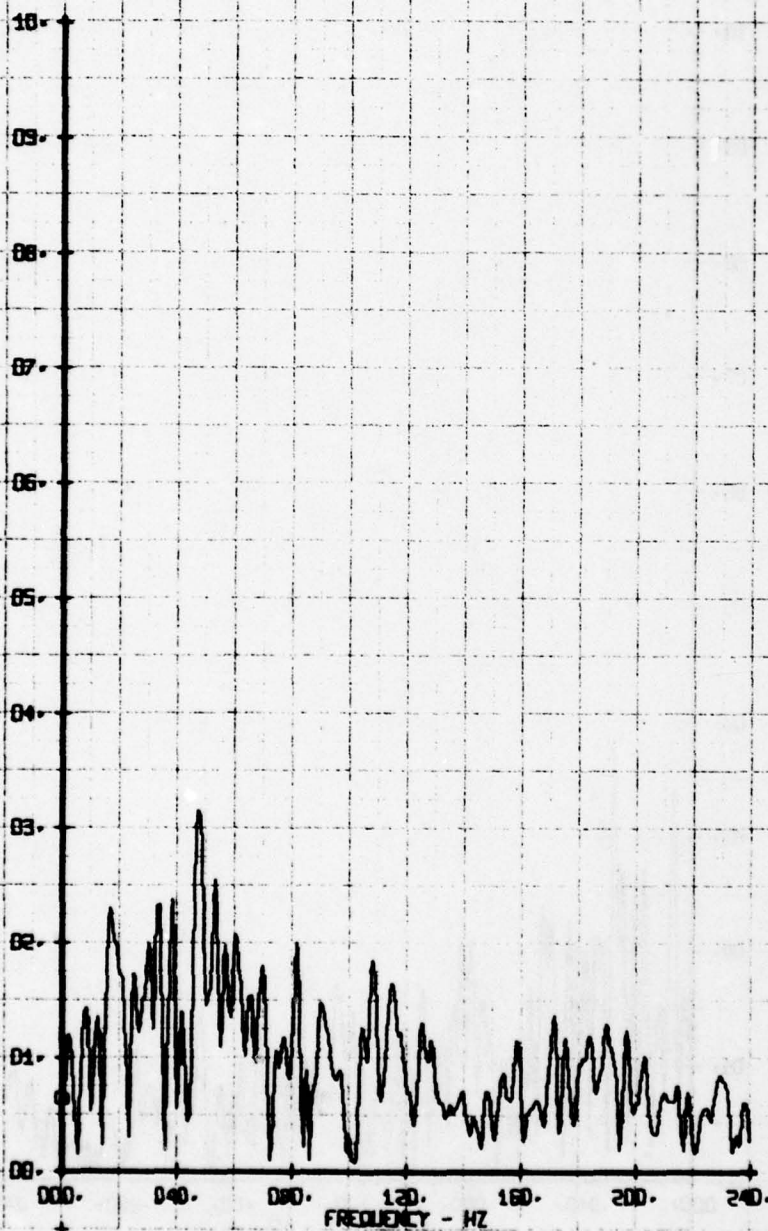
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U BLADES OFF, NON-ROT. HUB
RUN 158 TP 7

LEGEND
CH 66 PARAMETER
ALPHA

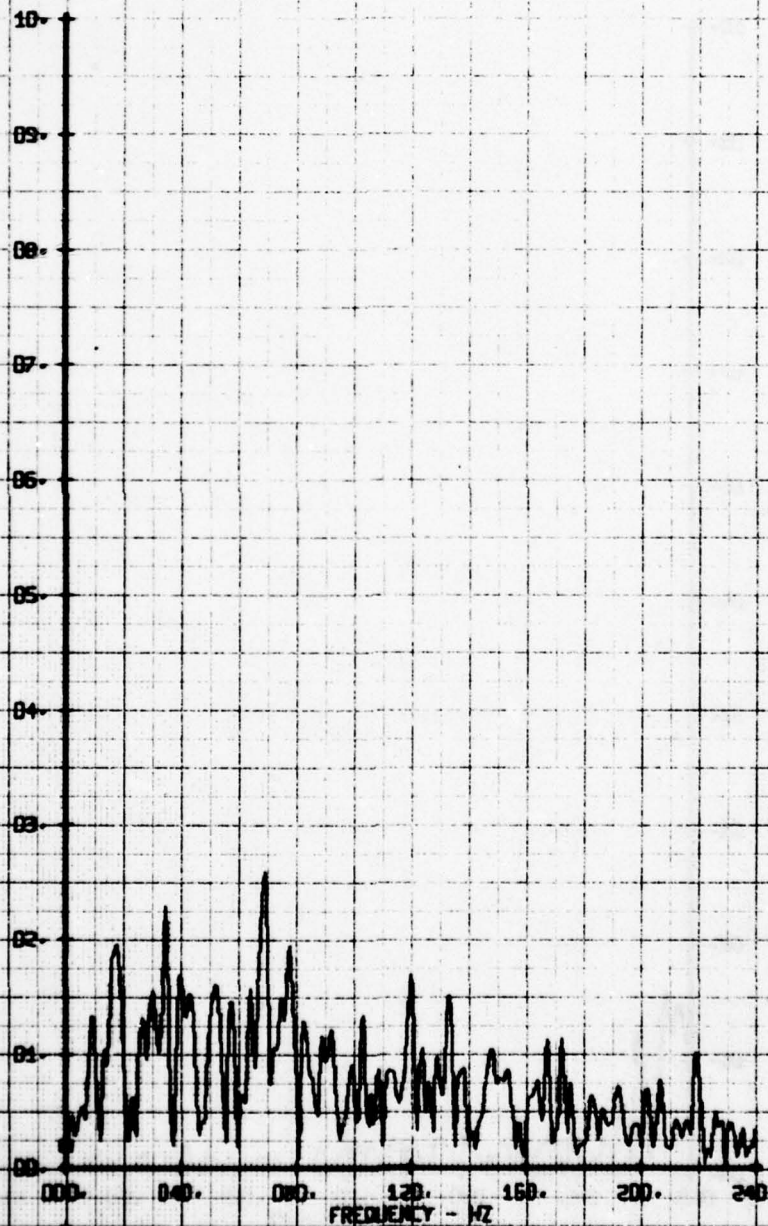
VERTICAL FLUX ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT. HUB
RUN 158 TP 8

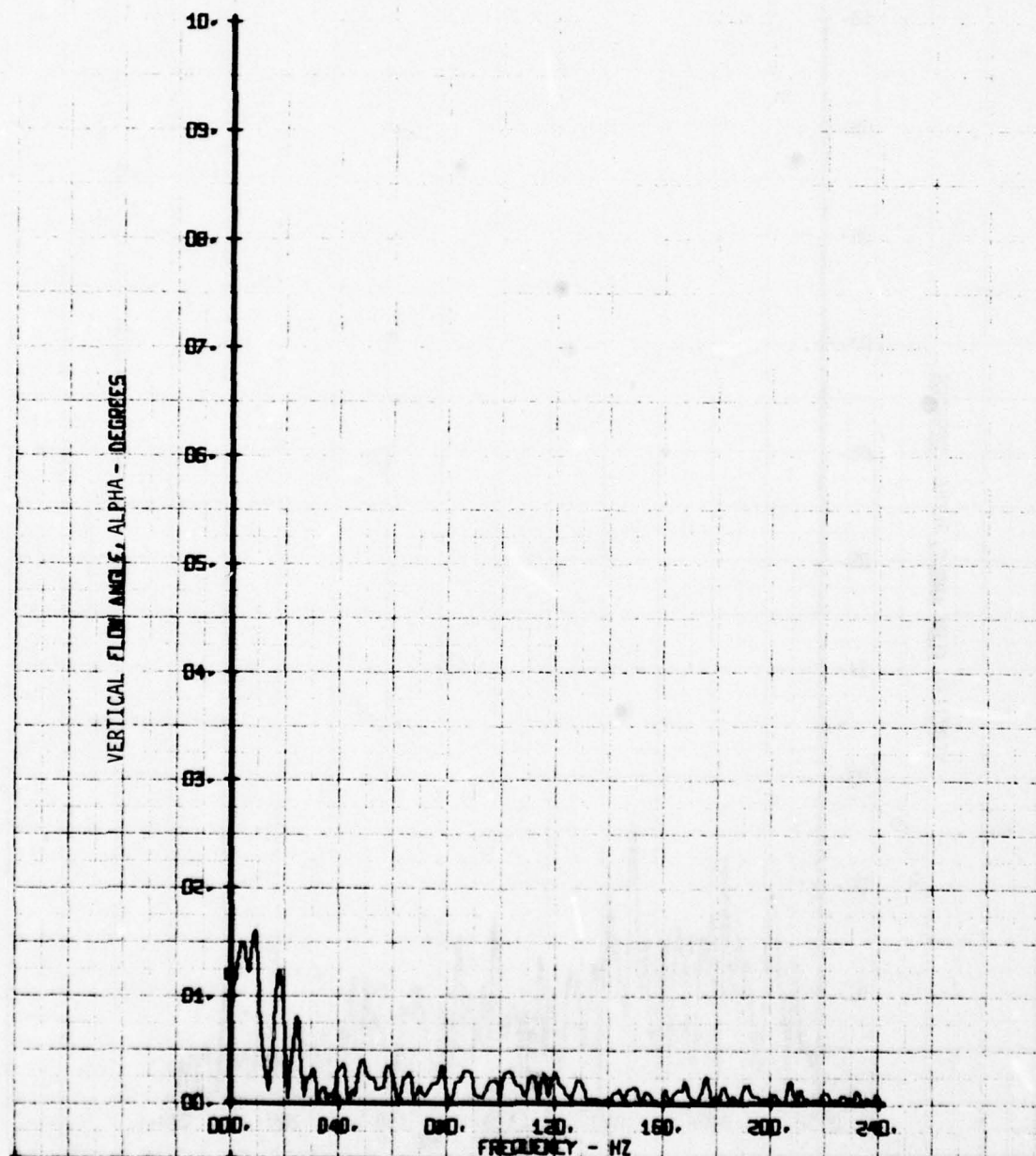
LEGEND
CH 66
PARAMETER
ALPHA

VERTICAL FLUX ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 9

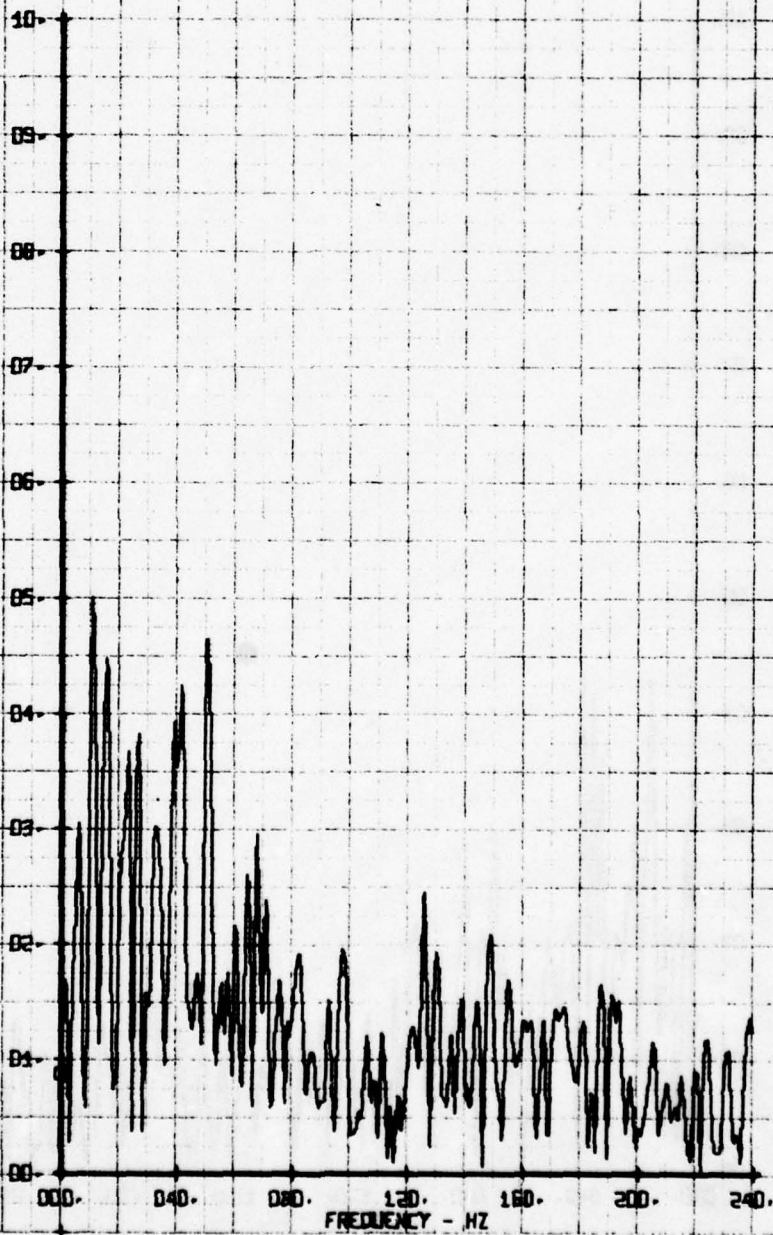
LEGEND
CH 66
PARAMETER
ALPHA



HOT FILM WIRE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT. HUB
RUN 158 TP 2

LEGEND
CH 65 PARAMETER
BETA

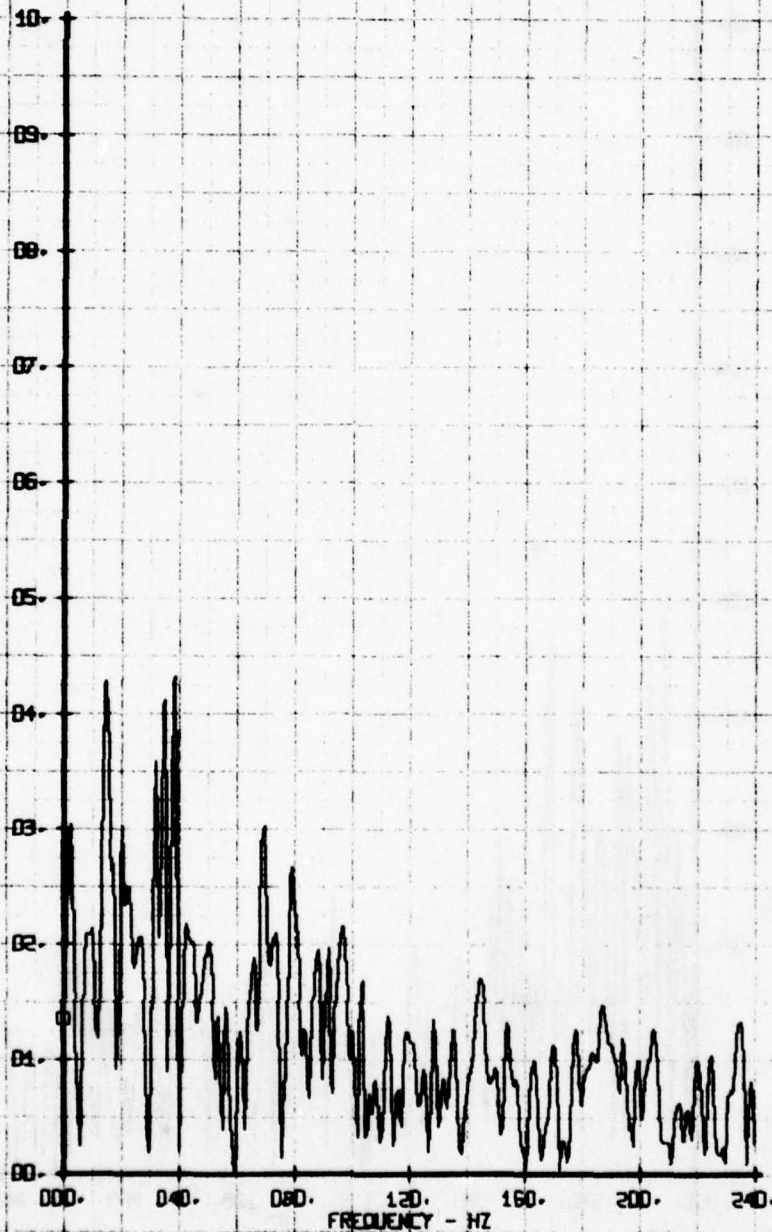
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT-HUB
RUN 159 TP 3

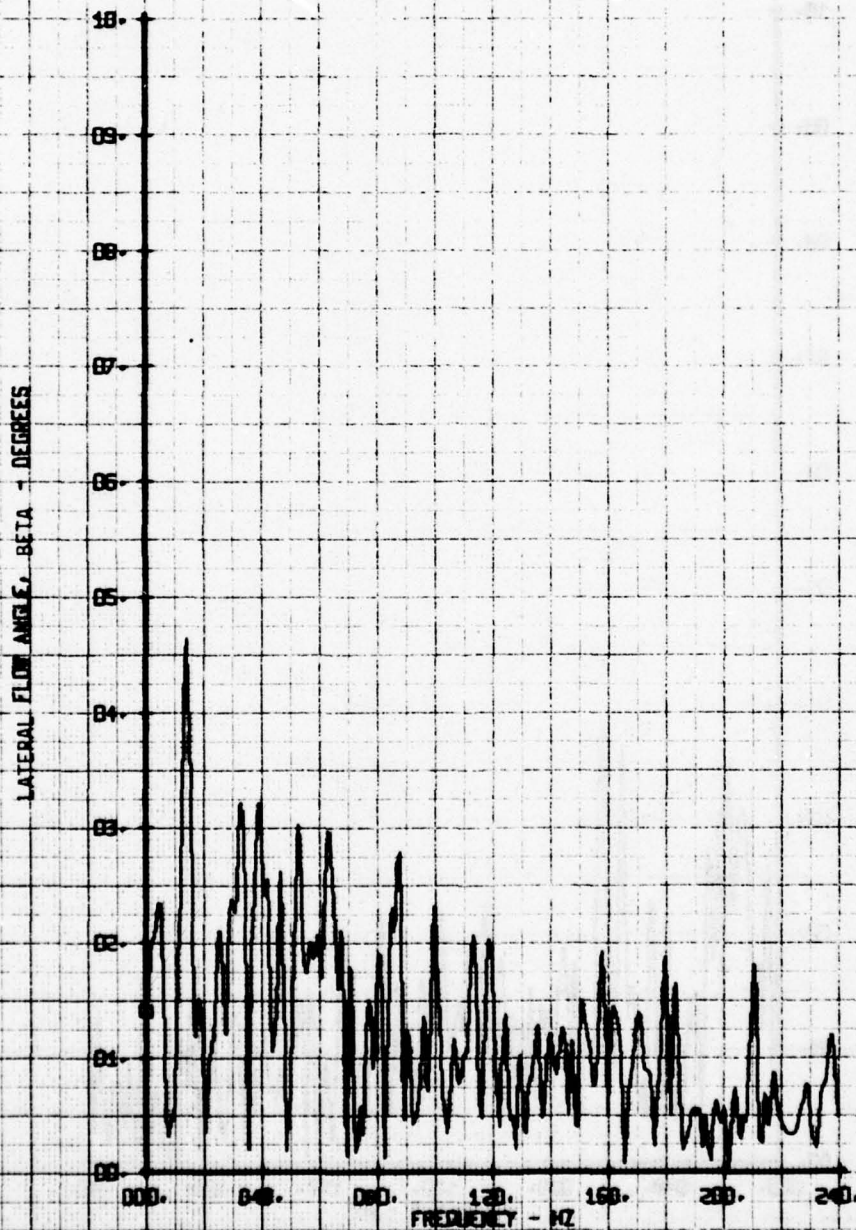
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



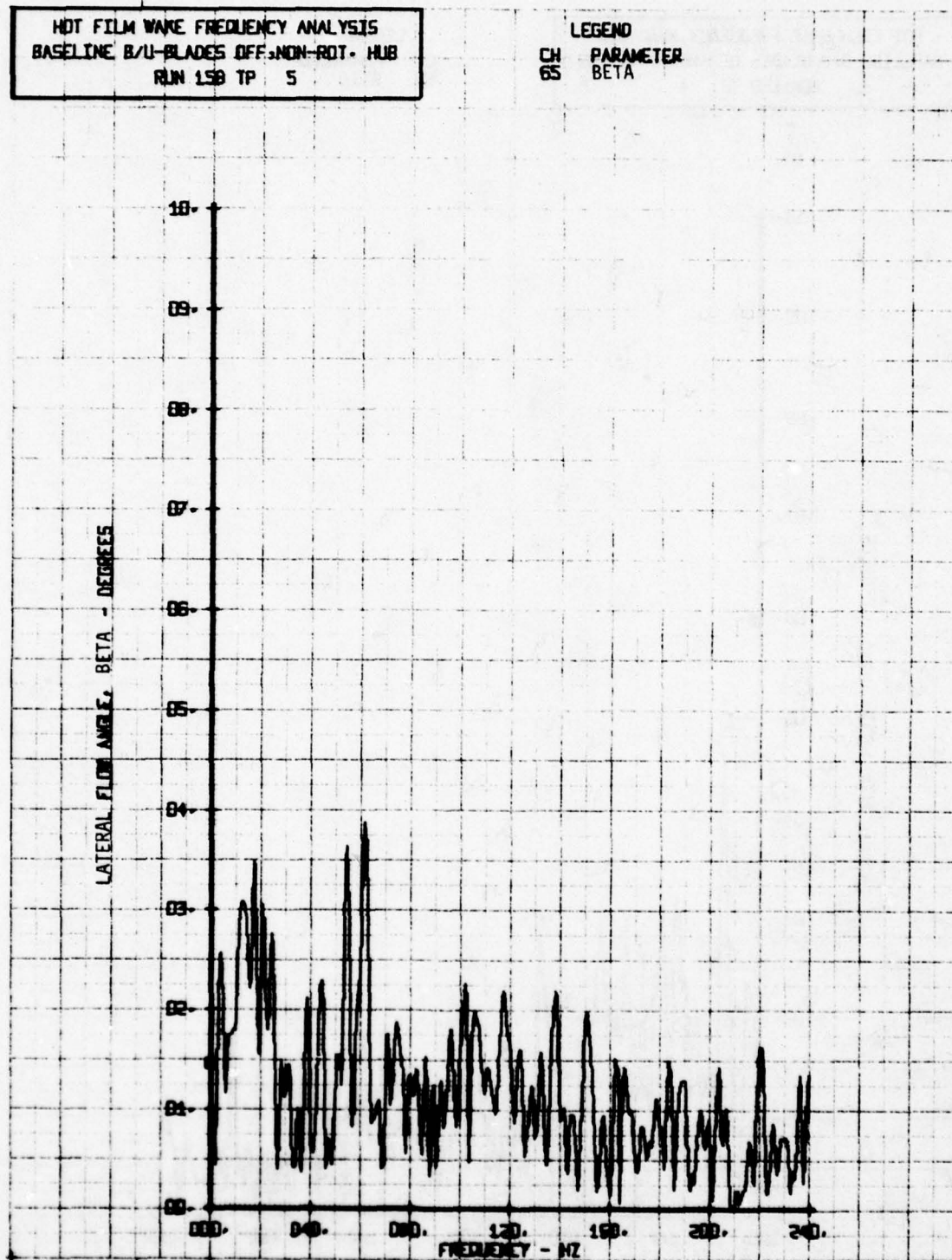
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 15B TP 4

LEGEND
CH 65 PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 5

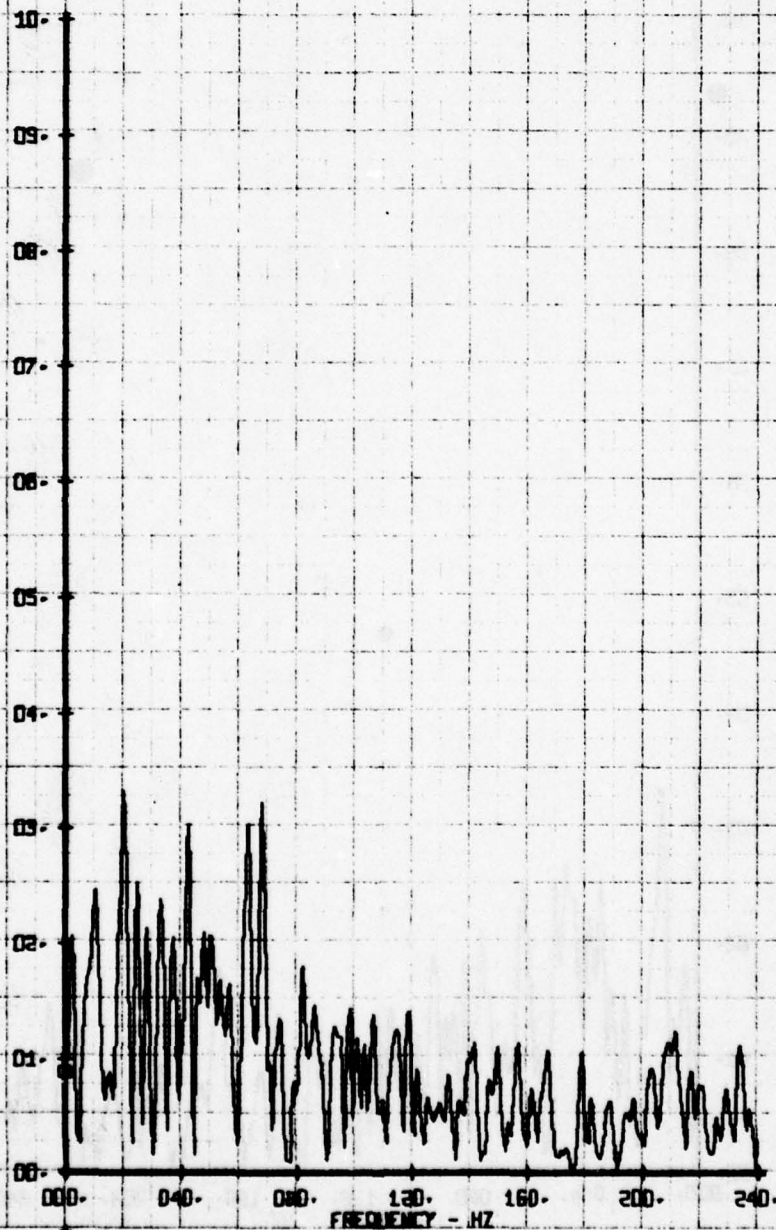
LEGEND
CH PARAMETER
65 BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 840 BLADES OFF, NON-ROT - HUB
RUN 158 TP 6

LEGEND
CH 65 PARAMETER
BETA

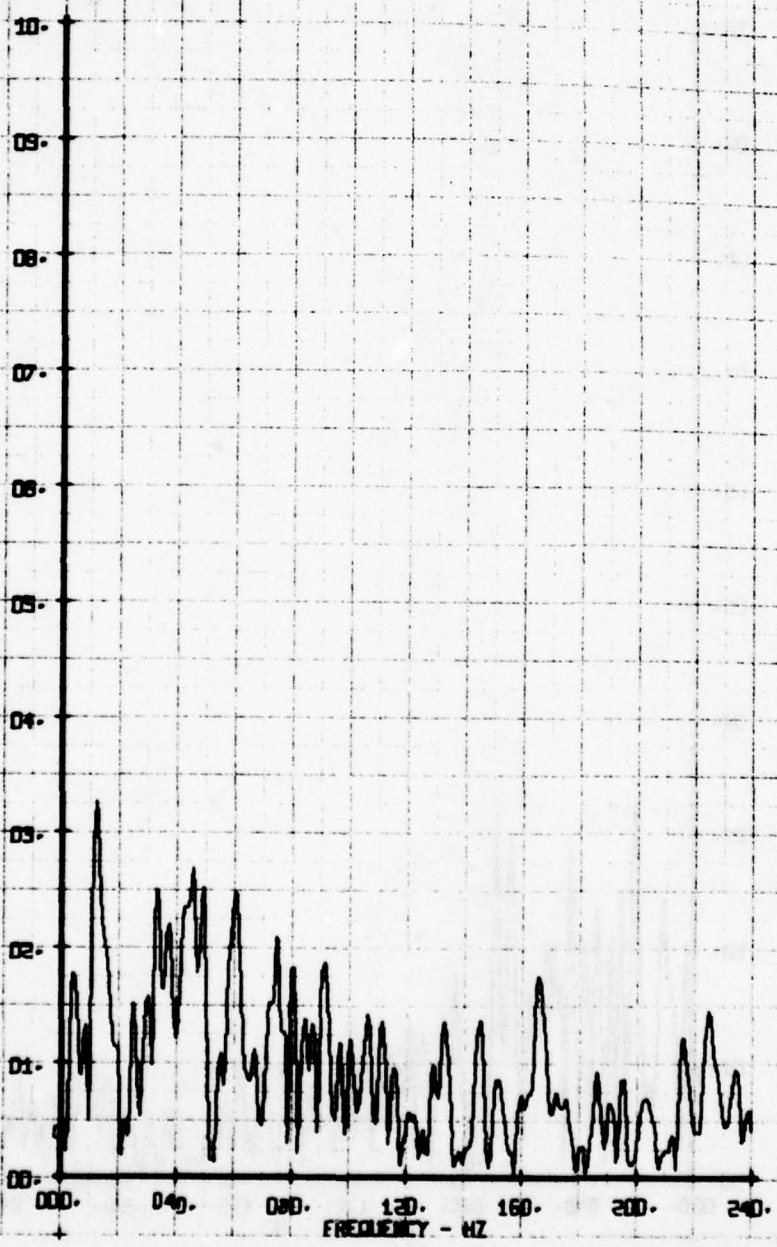
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/11 BLADES OFF-NON-ROT. HUB
RUN 159 TP 7

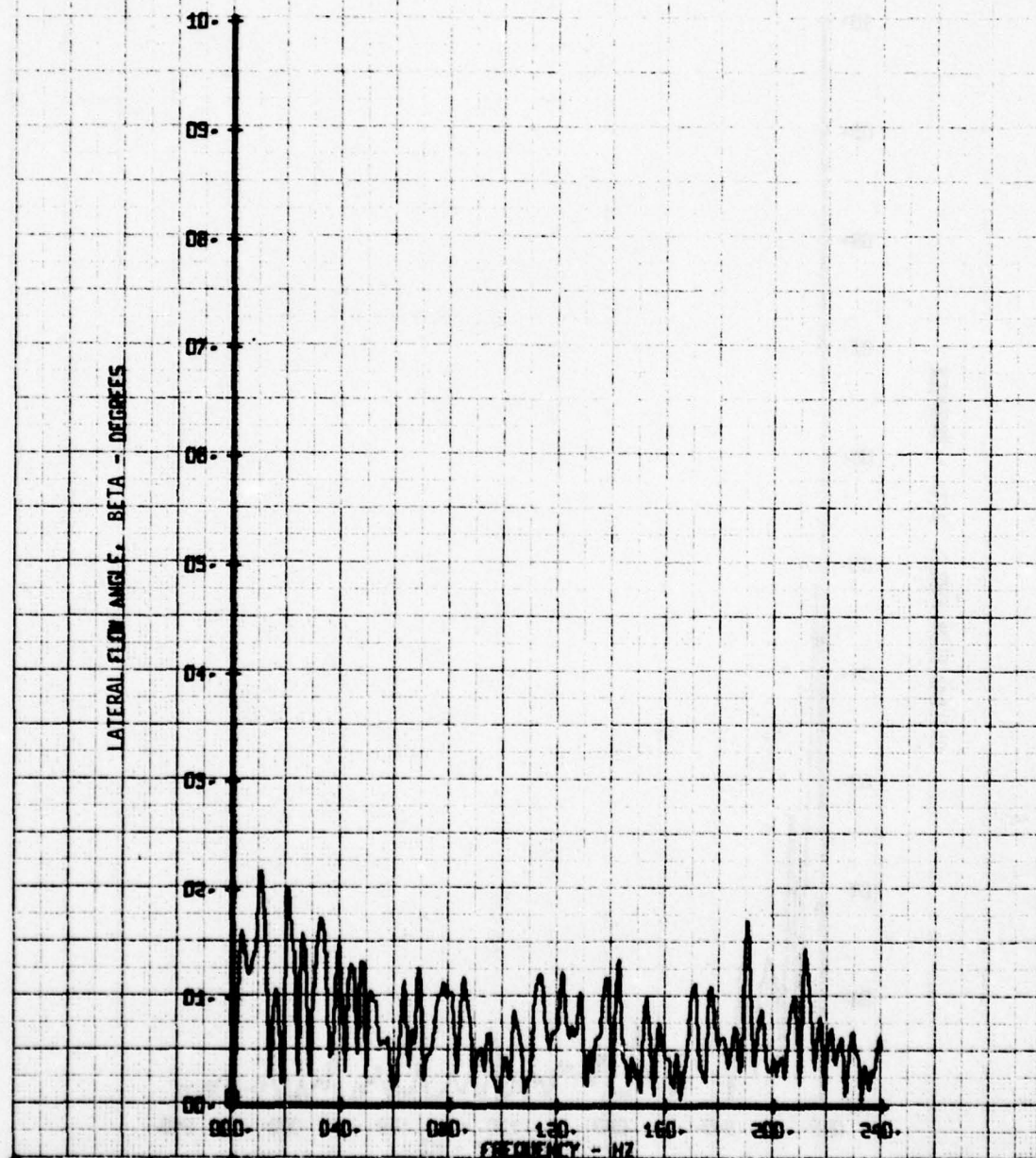
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



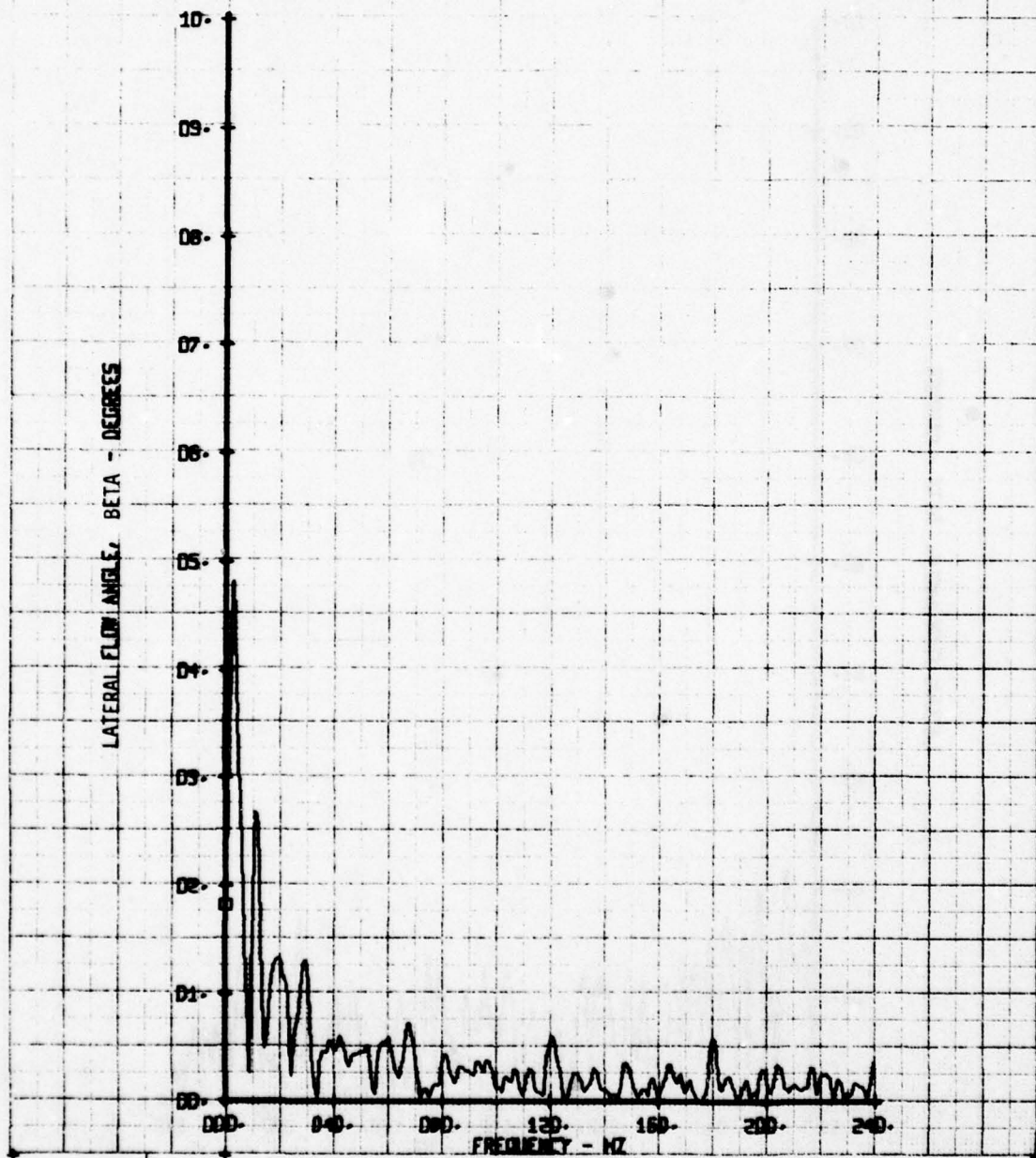
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 84- BLADES OFF, NON-ROT. HUB
RUN 158 TP 8

LEGEND
CH 65 PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 15B TP 9

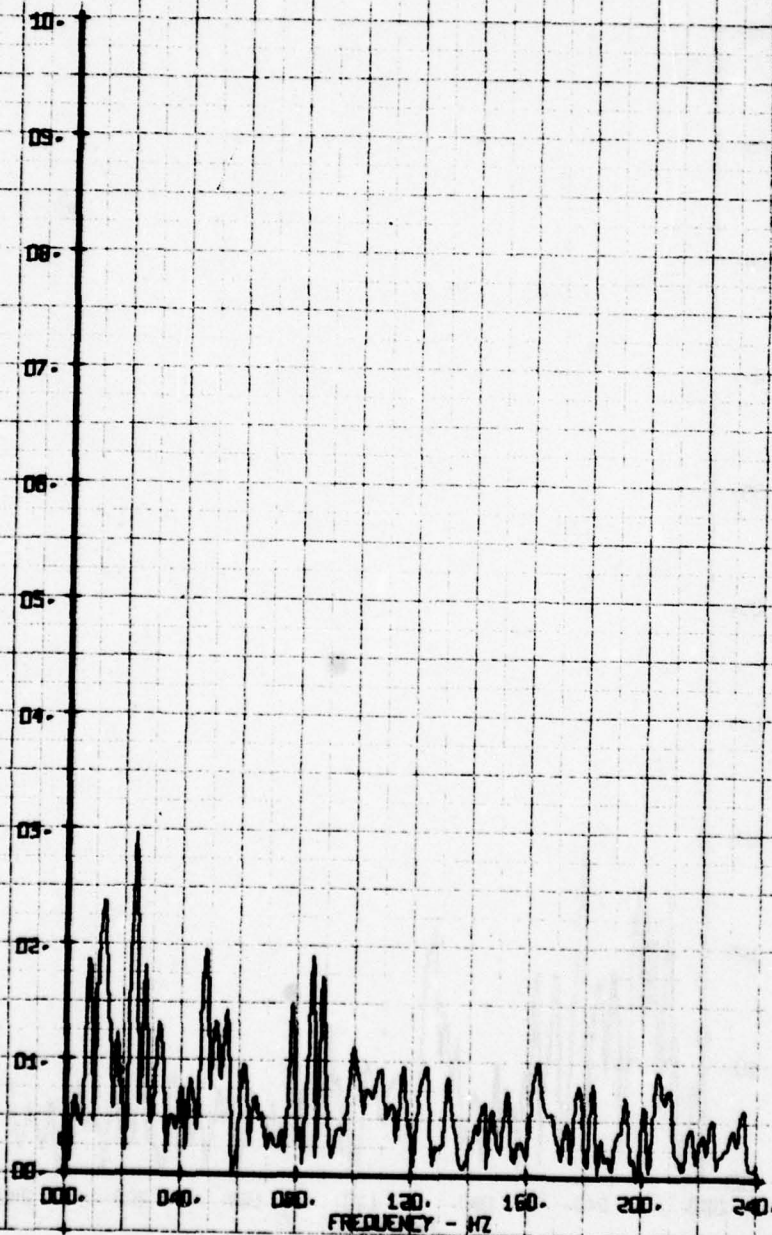
LEGEND
CH 65 PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/11-01 BLADES DEF-NON-ROT. HUB
RUN 158 TP 2

LEGEND
CH 66 PARAMETER
V-ALPHA

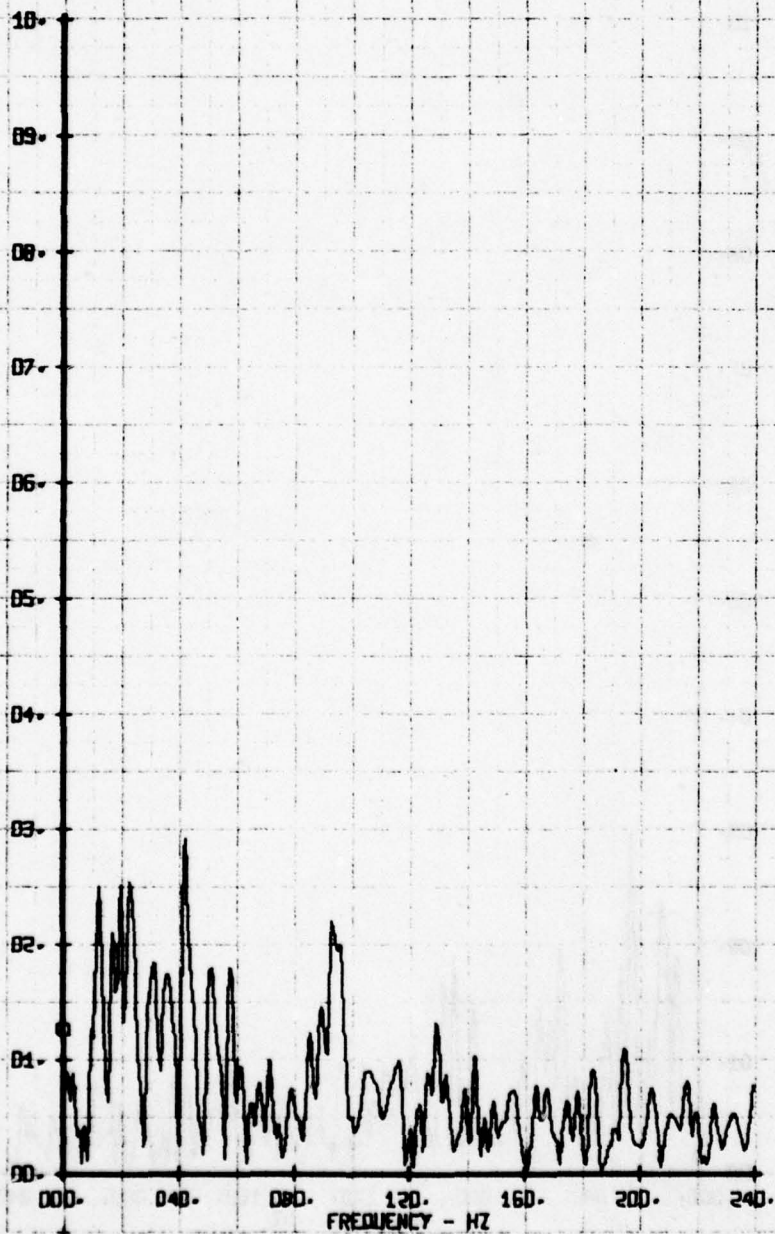
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/U-BLADES OFF-NON-ROT. HUB
RUN 158 TP 3

LEGEND
CH 66
PARAMETER
V-ALPHA

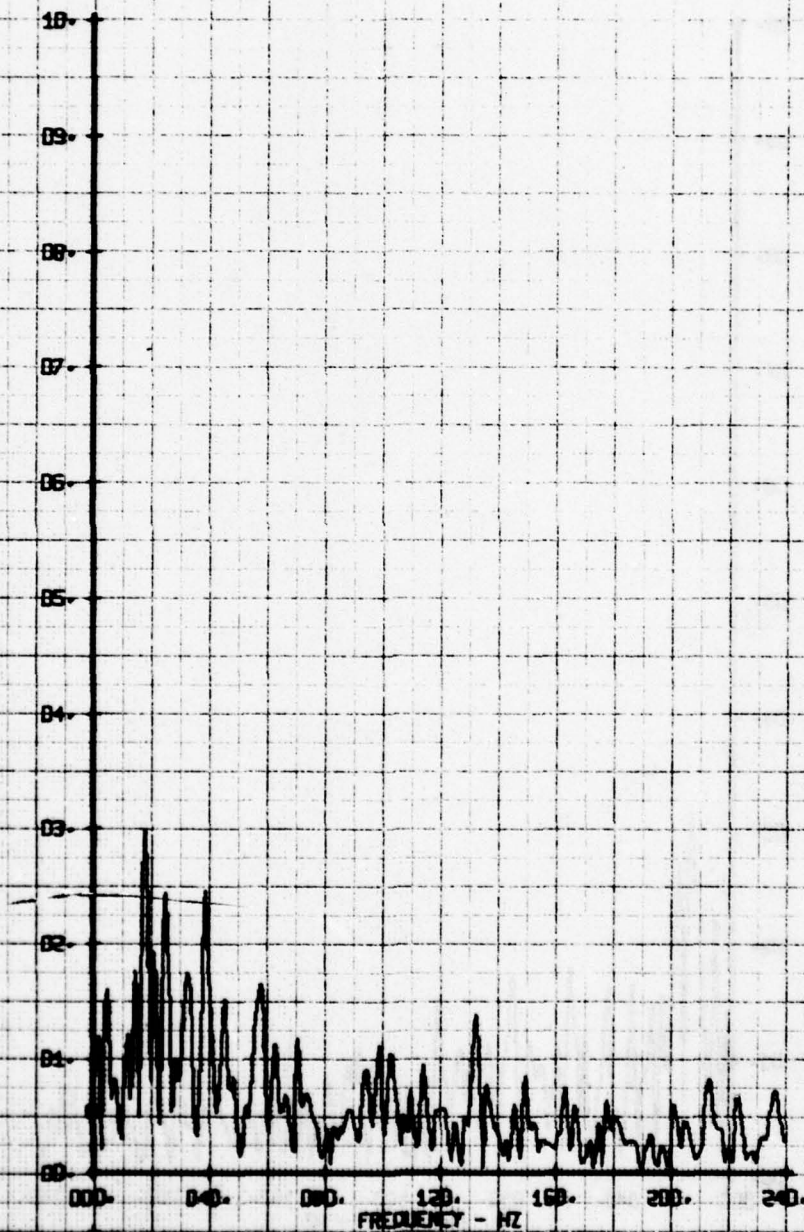
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 4

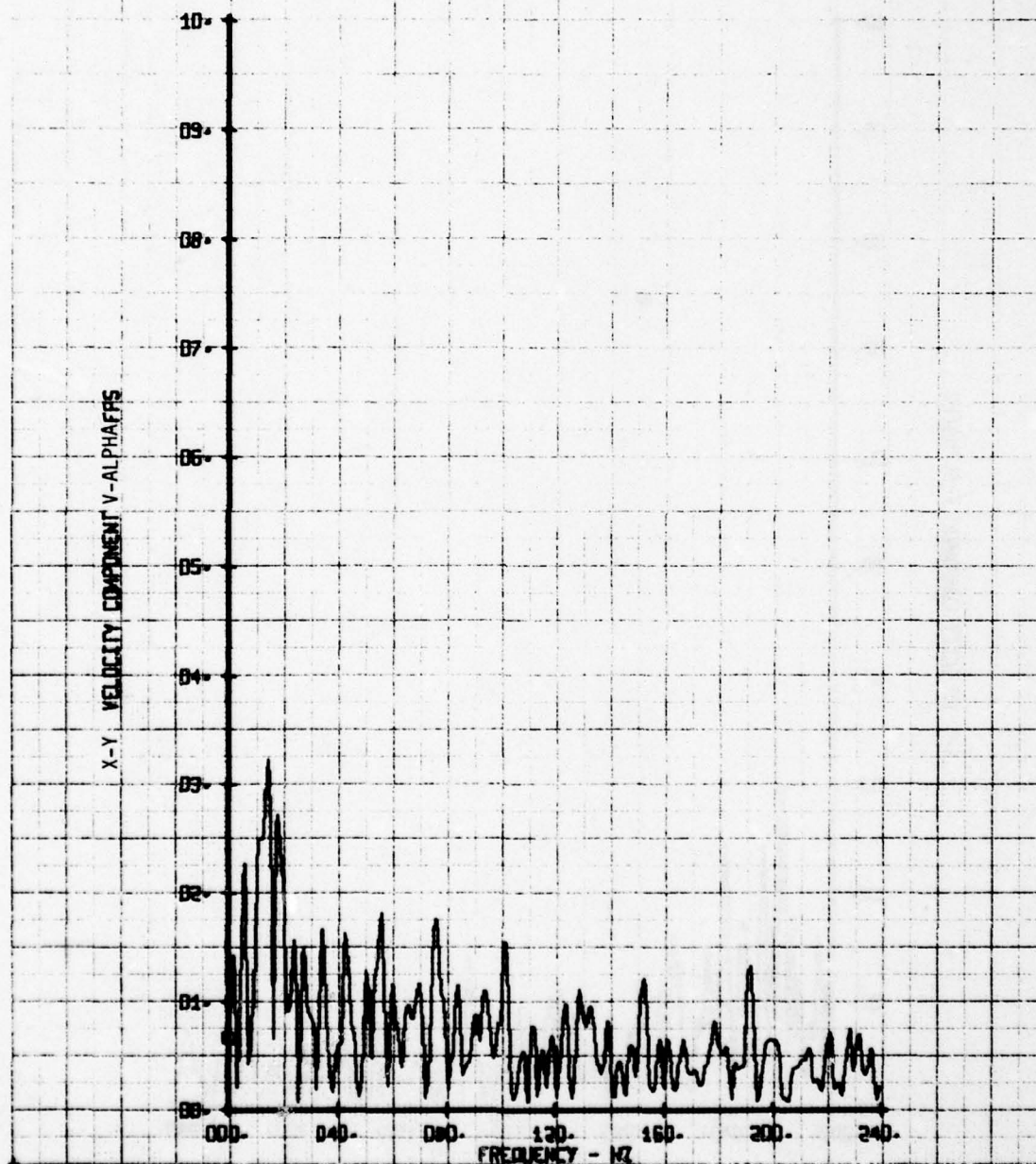
LEGEND
CH: PARAMETER
66 V-ALPHA

X-Y VELOCITY COMPONENT V-ALPHAS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 15B TP 5

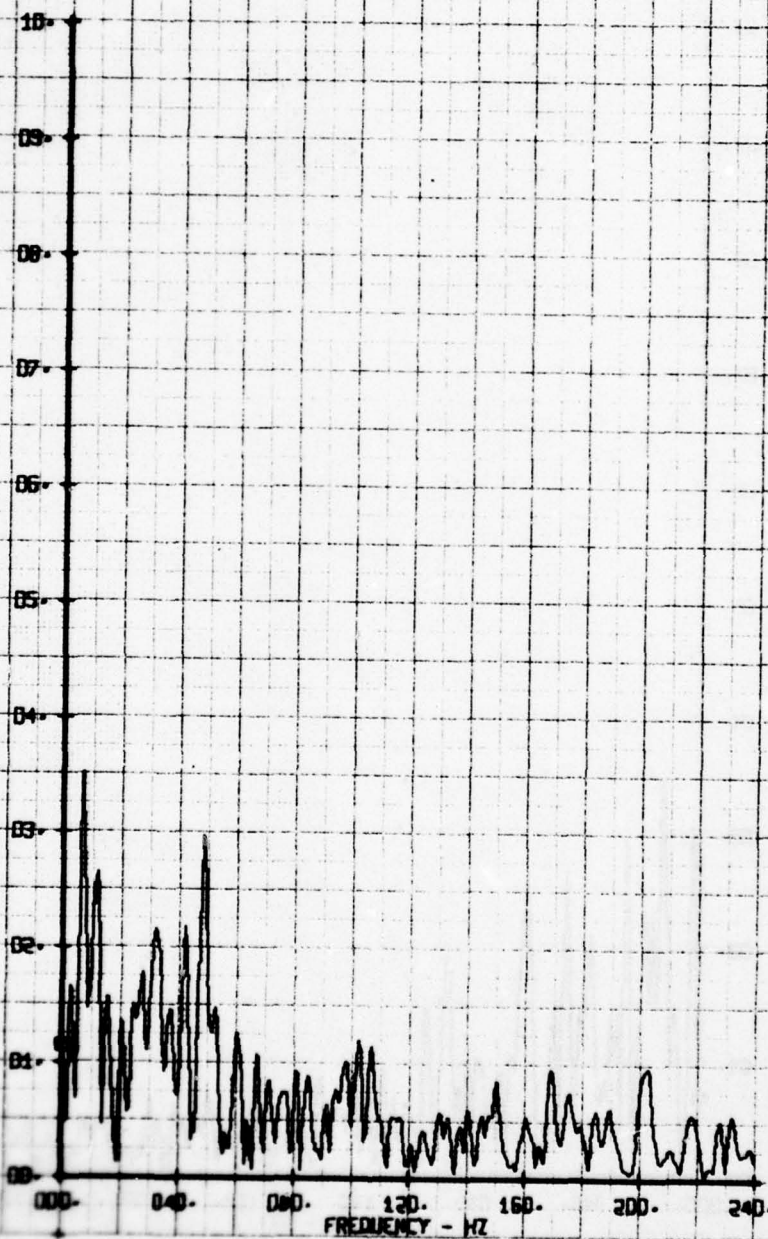
LEGEND
CH 66
PARAMETER
V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 840-PLACES OFF-NON-ROT. HUB
RUN 158 TP 6

LEGEND
CH 66 PARAMETER
V-ALPHA

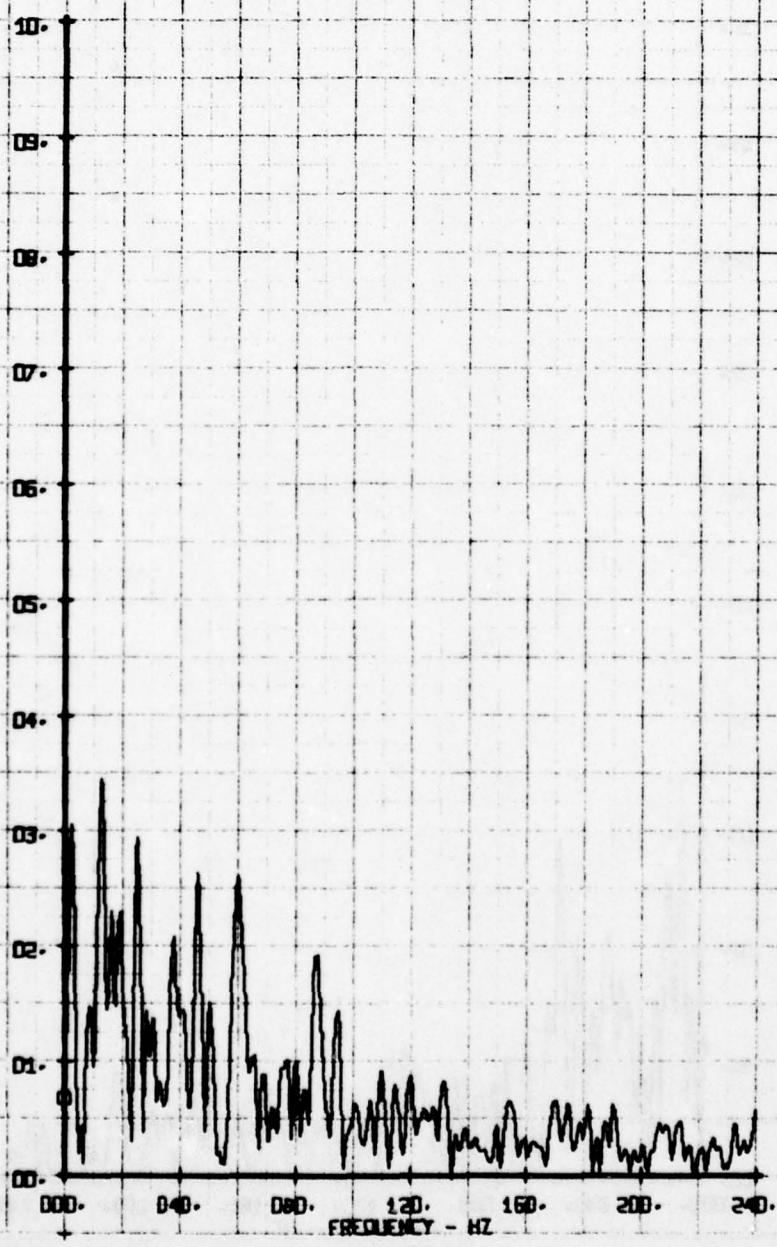
X-Y VELOCITY COMPONENT V-ALPHAFFS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/10-BLADES OFF, NON-ROT. HUB
RUN 158 TP 7

LEGEND
CH- PARAMETER
66 V-ALPHA

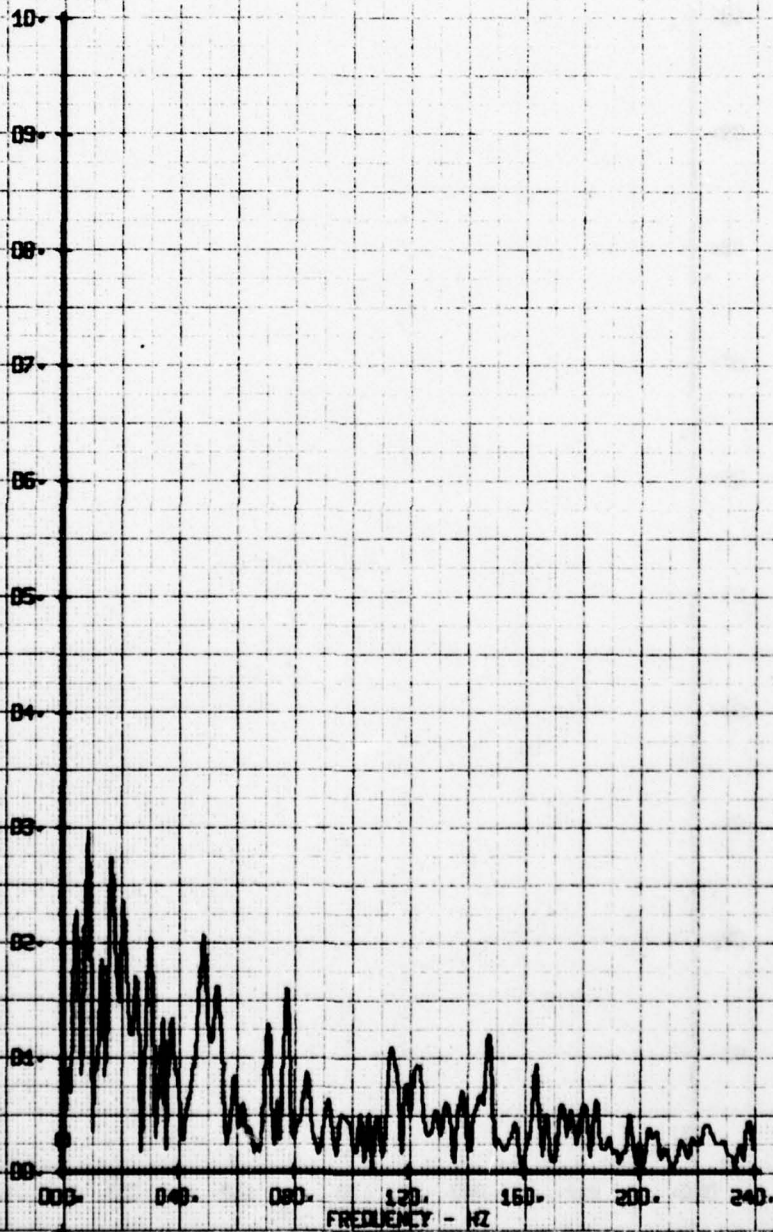
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT, HUB
RUN 158 TP 8

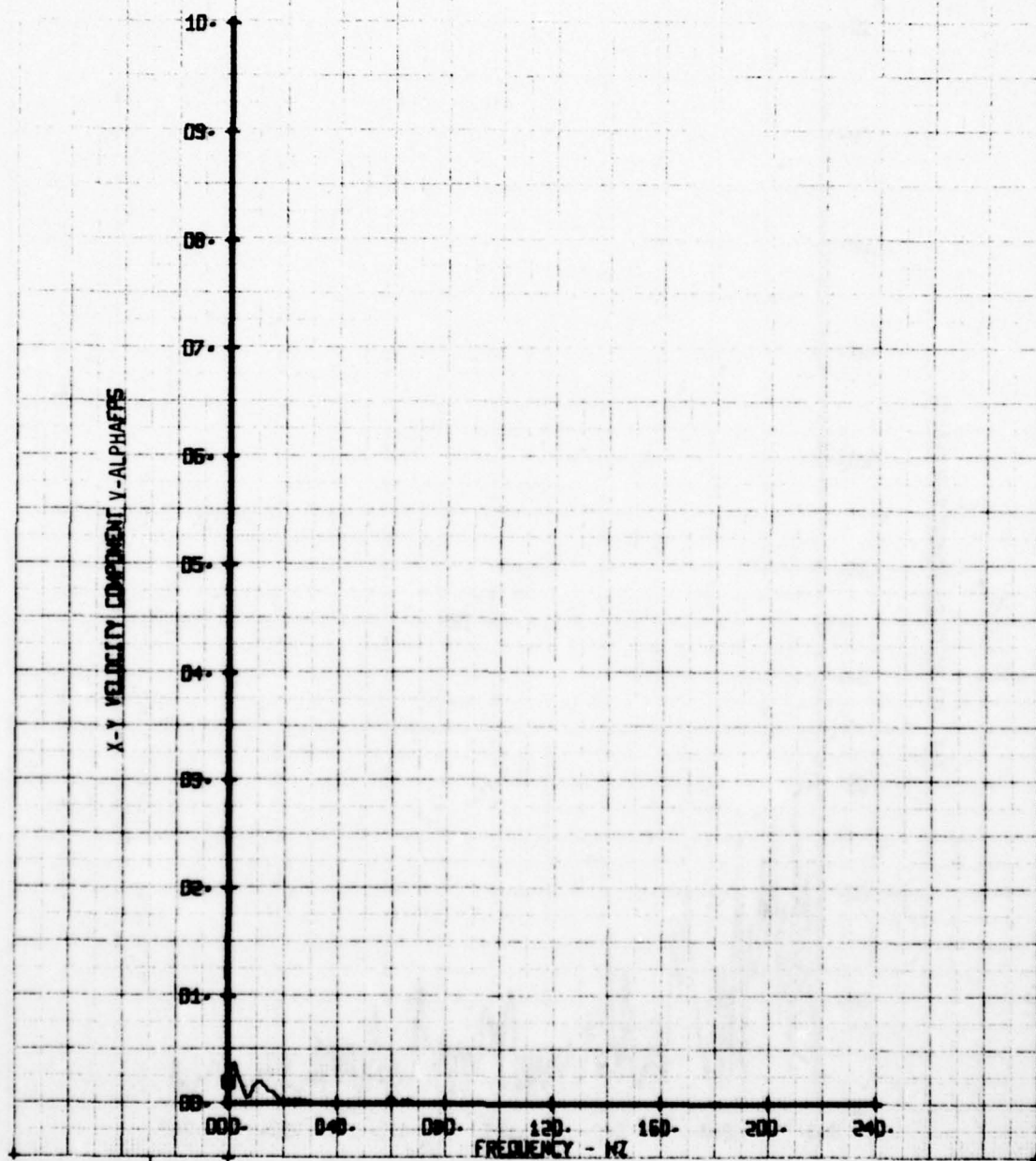
LEGEND
CH 66
PARAMETER
V-ALPHA

X-Y VELOCITY DIFFERENCE V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT-HUB
RUN 158 TP 9

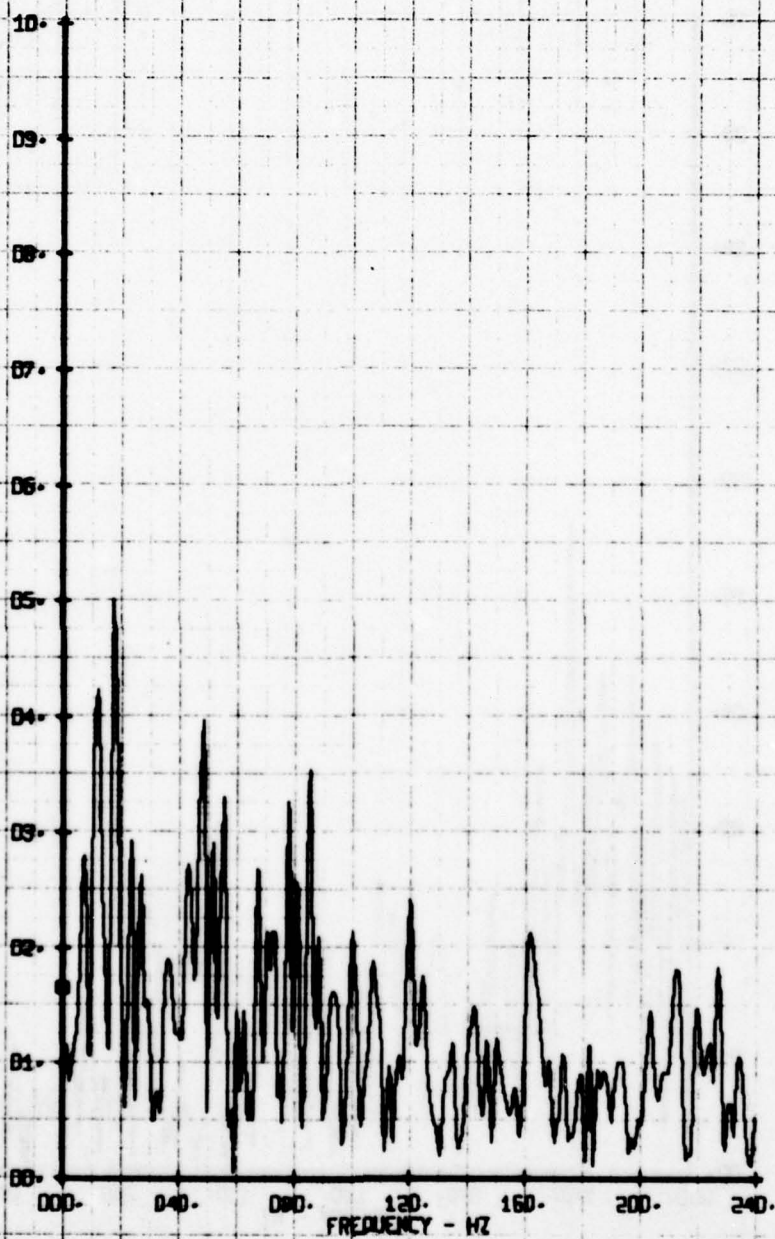
LEGEND
CH 66
PARAMETER
V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 2

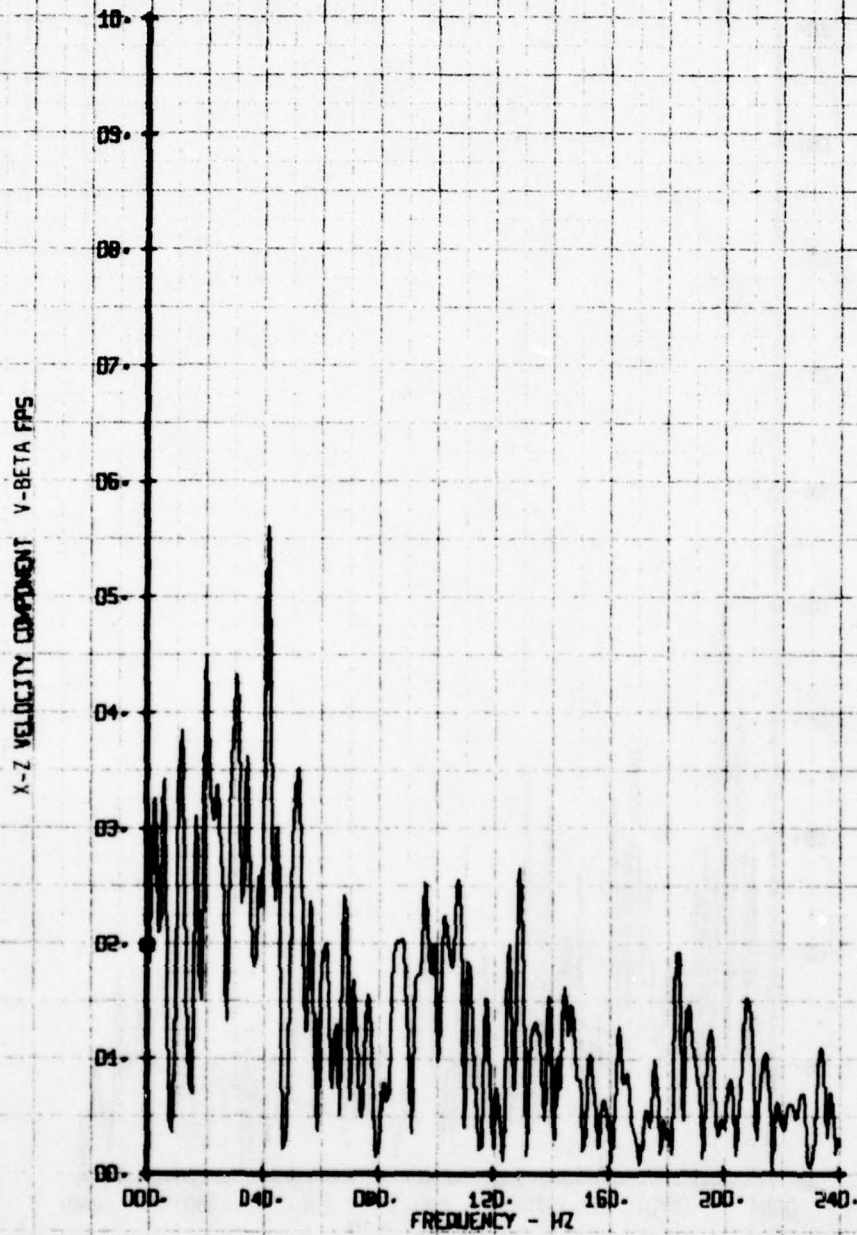
LEGEND
CH 65 PARAMETER
V-BETA

X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 3

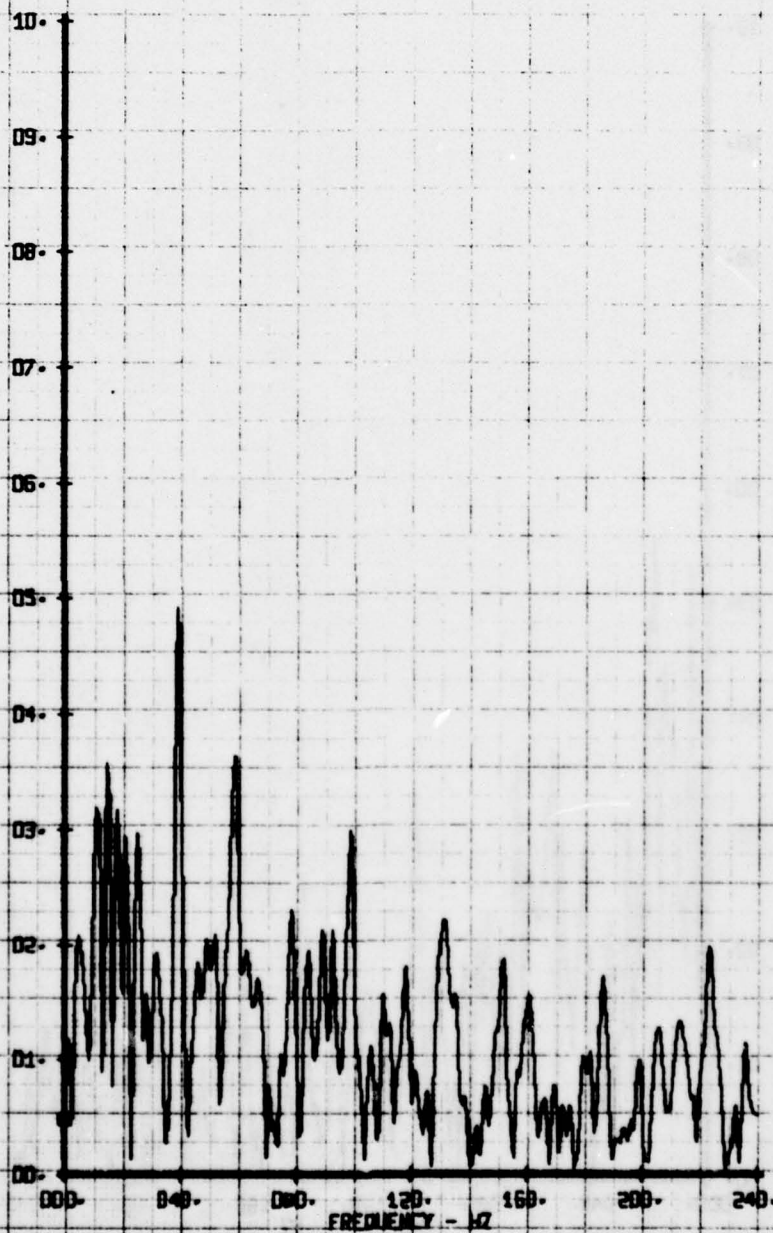
LEGEND
CH 65
PARAMETER
V-BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF-NON-ROT-HUB
RUN 158 TP 4

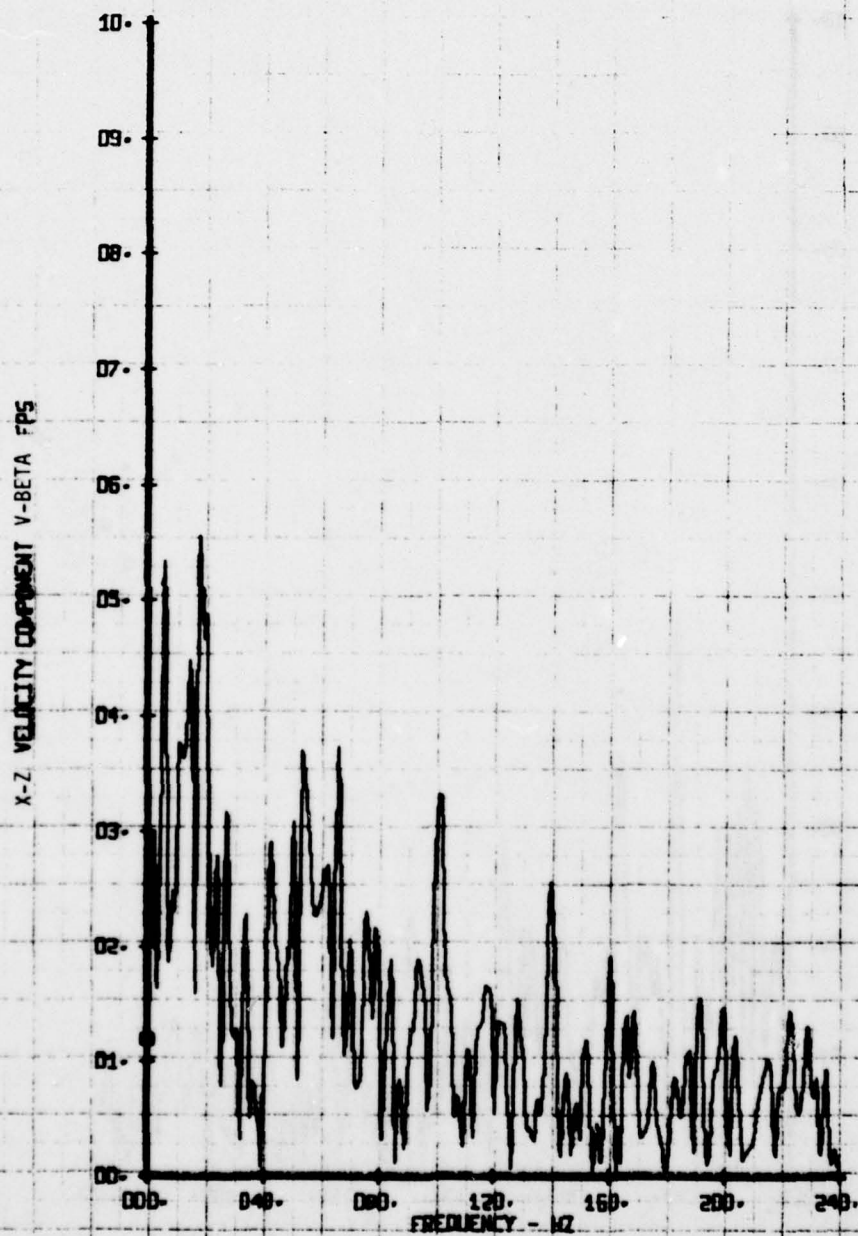
LEGEND
CH 65
PARAMETER
V-BETA

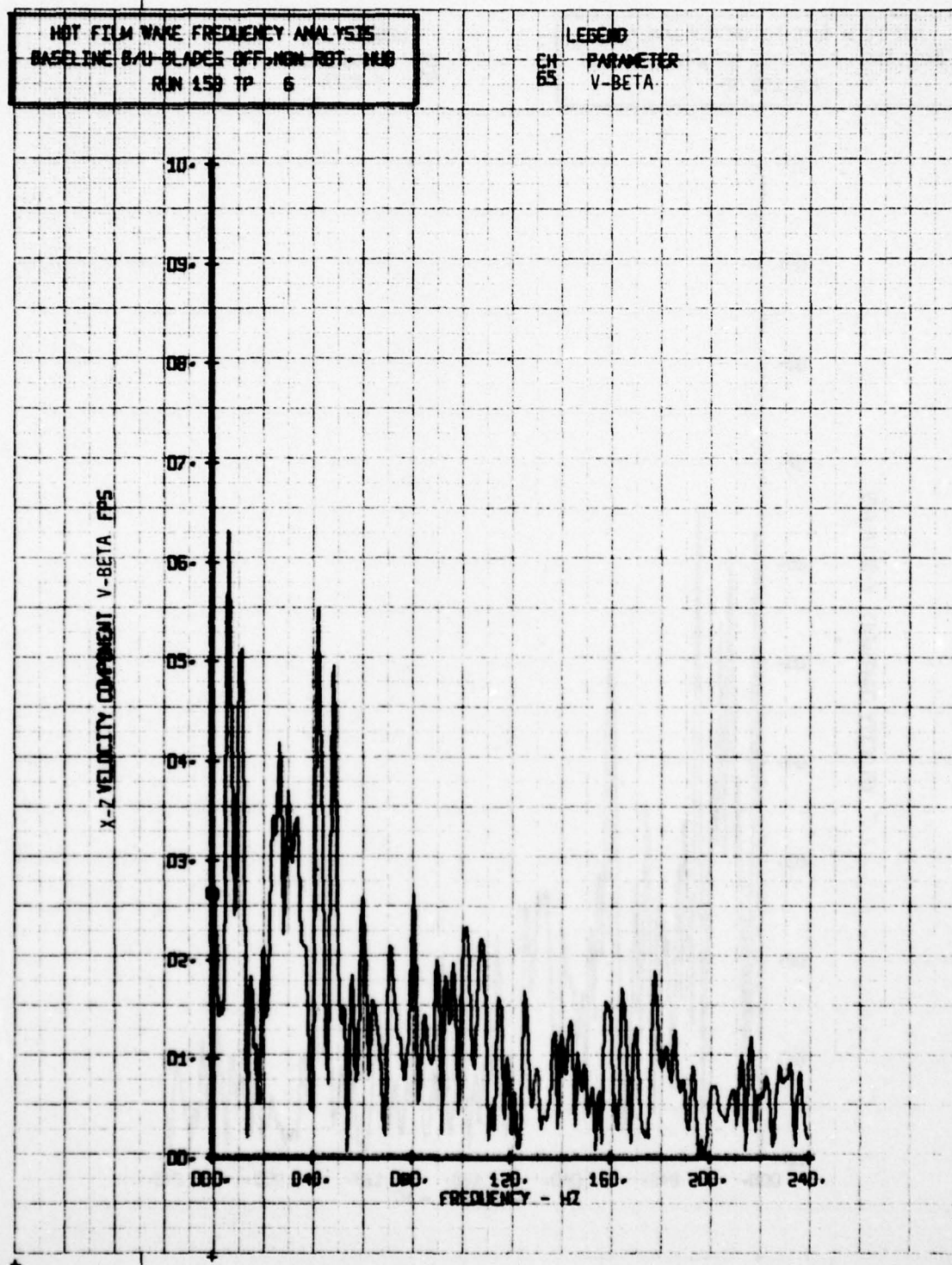
X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE BAU-BLADES OFF, NON-ROT-HUB
RUN 158 TP 5

LEGEND
CH 65 PARAMETER
V-BETA

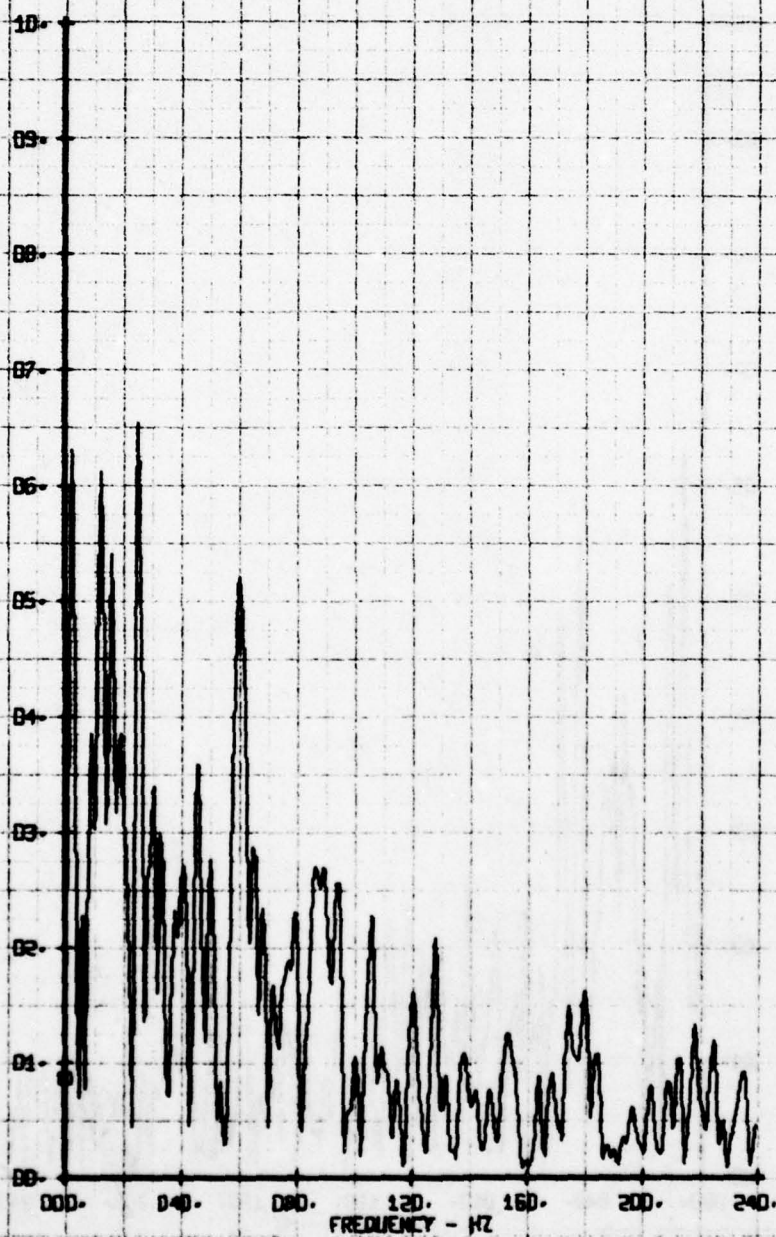




HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 159 TP 7

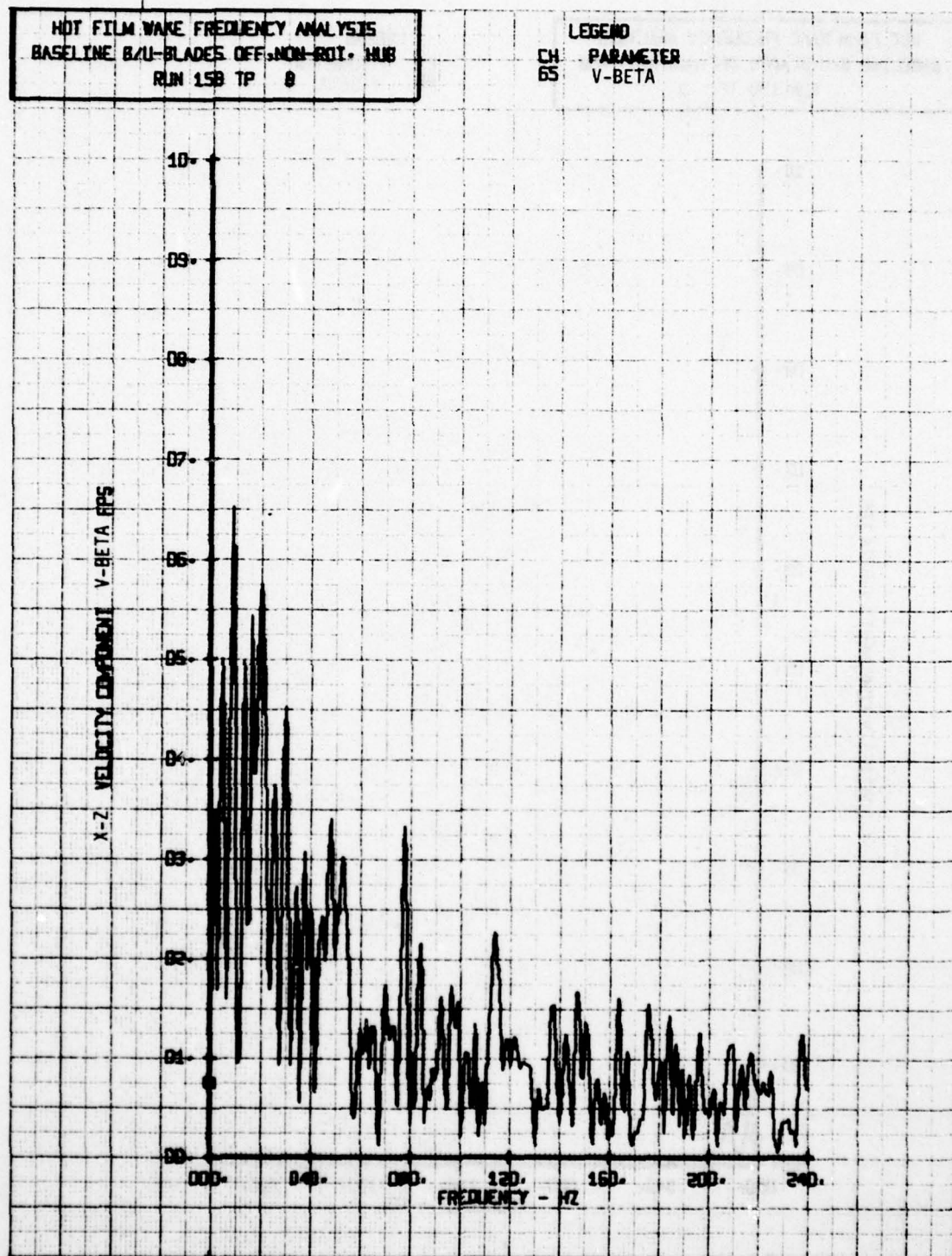
LEGEND
CH 65
PARAMETER
V-BETA

X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 8

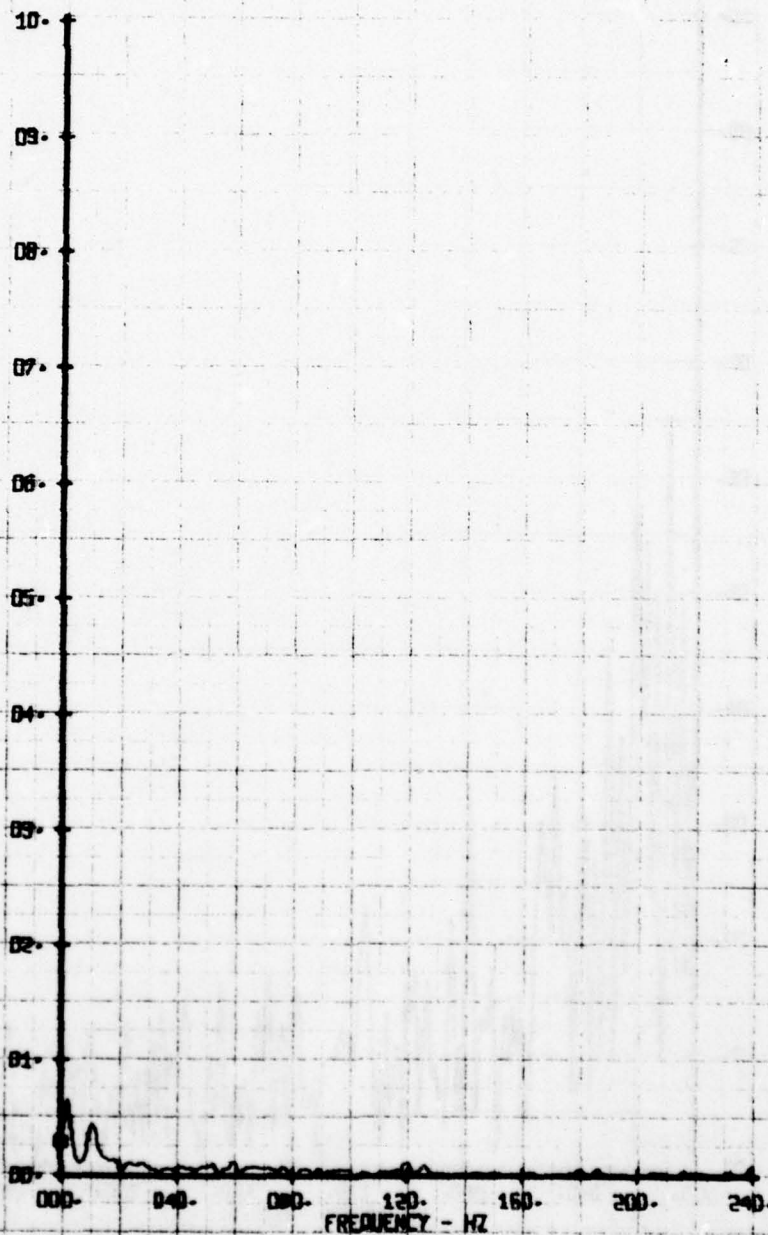
LEGEND
CH 65 PARAMETER
V-BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, NON-ROT. HUB
RUN 158 TP 9

LEGEND
CH 65
PARAMETER
V-BETA

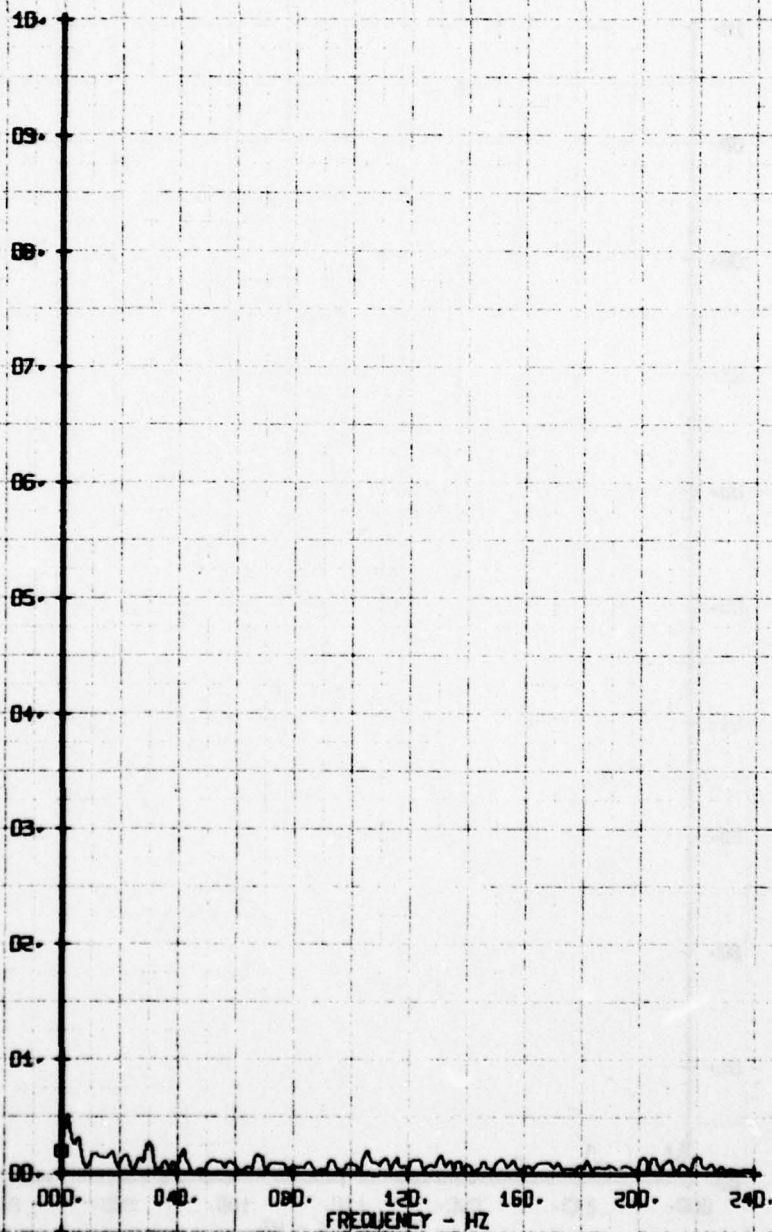
X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 159 TP 1

LEGEND
CH 66 PARAMETER
ALPHA

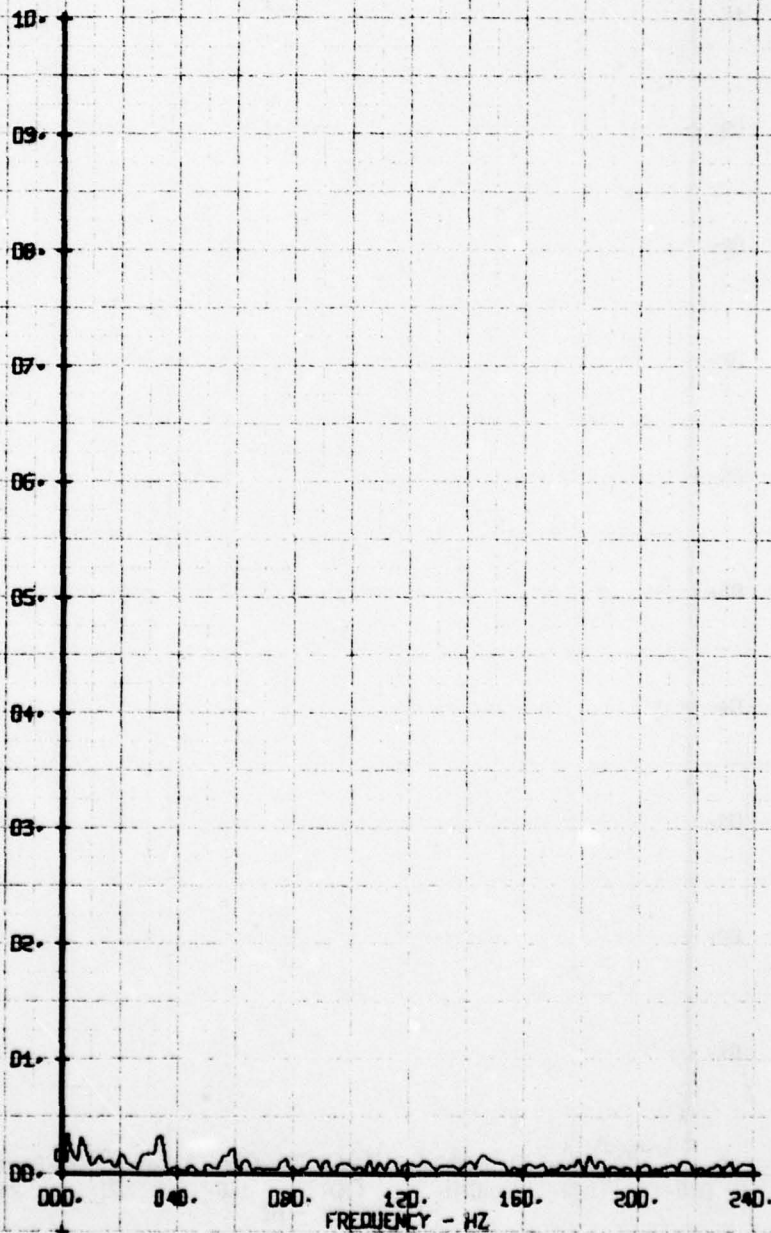
VERTICAL FLOW ANGLE, ALPHA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/L-BLADES OFF, HUB OFF
RUN 158 TP 2

LEGEND
CM 66
PARAMETER
ALPHA

VERTICAL FLOW ANGLE, ALPHA - DEGREES



AD-A062 639

BOEING VERTOL CO PHILADELPHIA PA
INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONF--ETC(U)
SEP 78 P F SHERIDAN

F/G 1/3

DAAJ02-77-C-0020

UNCLASSIFIED

USARTL-TR-78-236-V-7A

NL

3 OF 3
ADA
062639

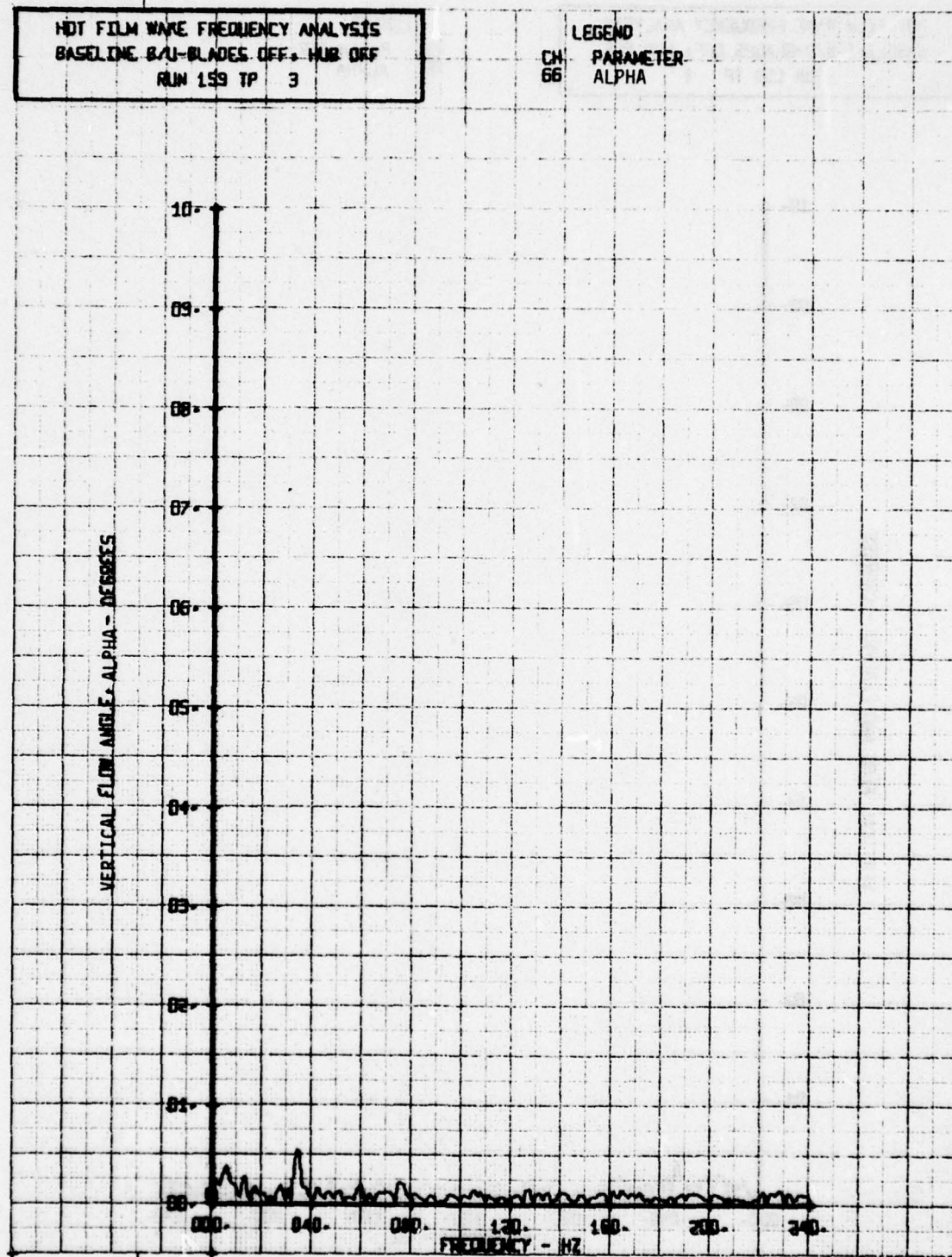
RE
FILE

END
DATE
FILMED

3 79
DDC

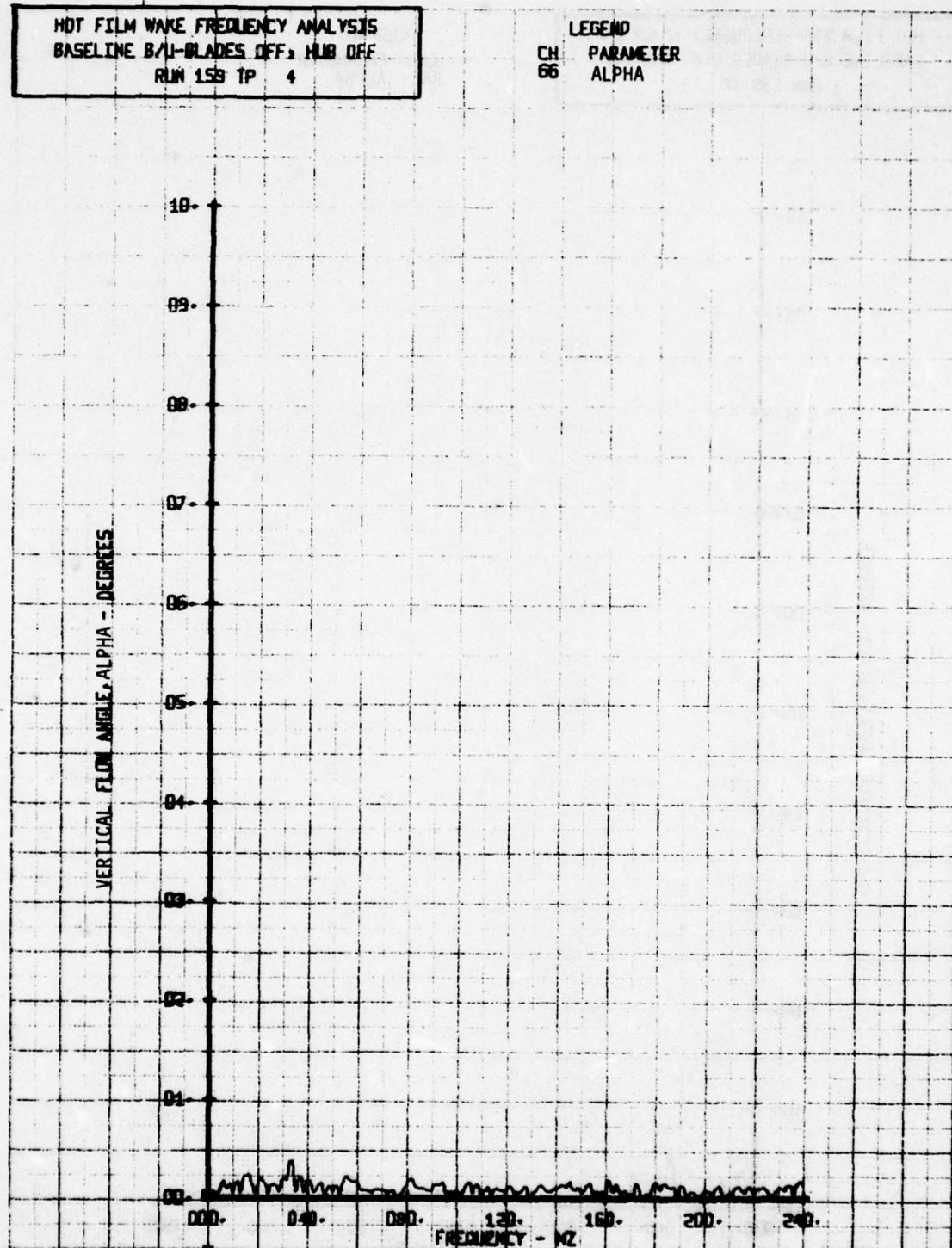
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/U-BLADES OFF, HUB OFF
RUN 159 TP 3

LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 158 TP 4

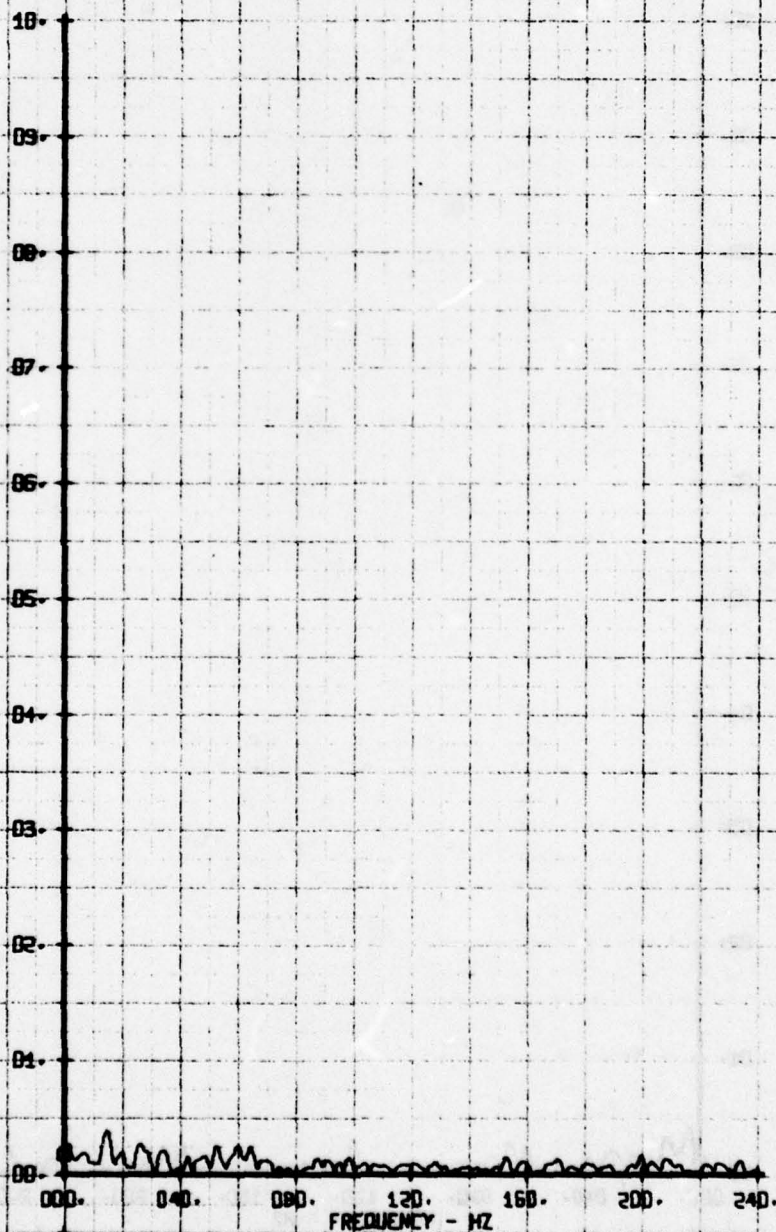
LEGEND
CH 66 PARAMETER
ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 158 TP 5

LEGEND
CH 66
PARAMETER
ALPHA

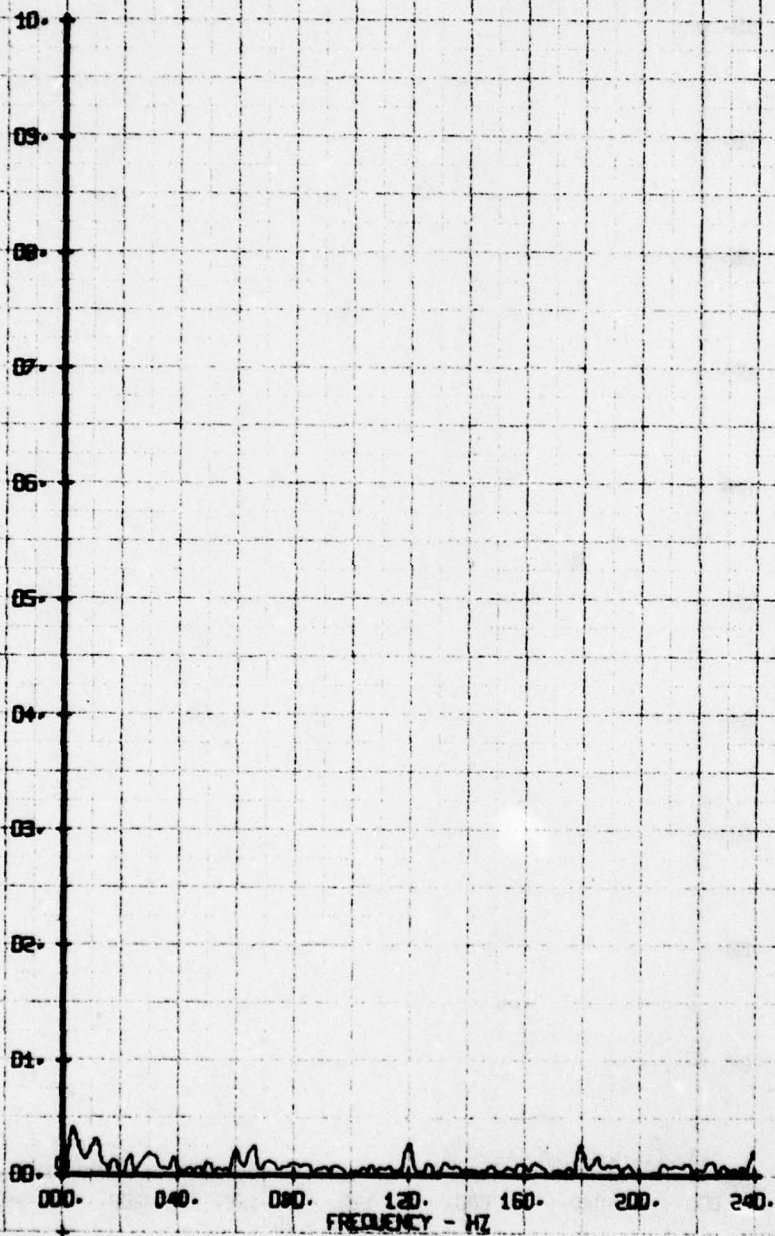
VERTICAL FLOW ANGLE, ALPHA- DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 159 TP 1

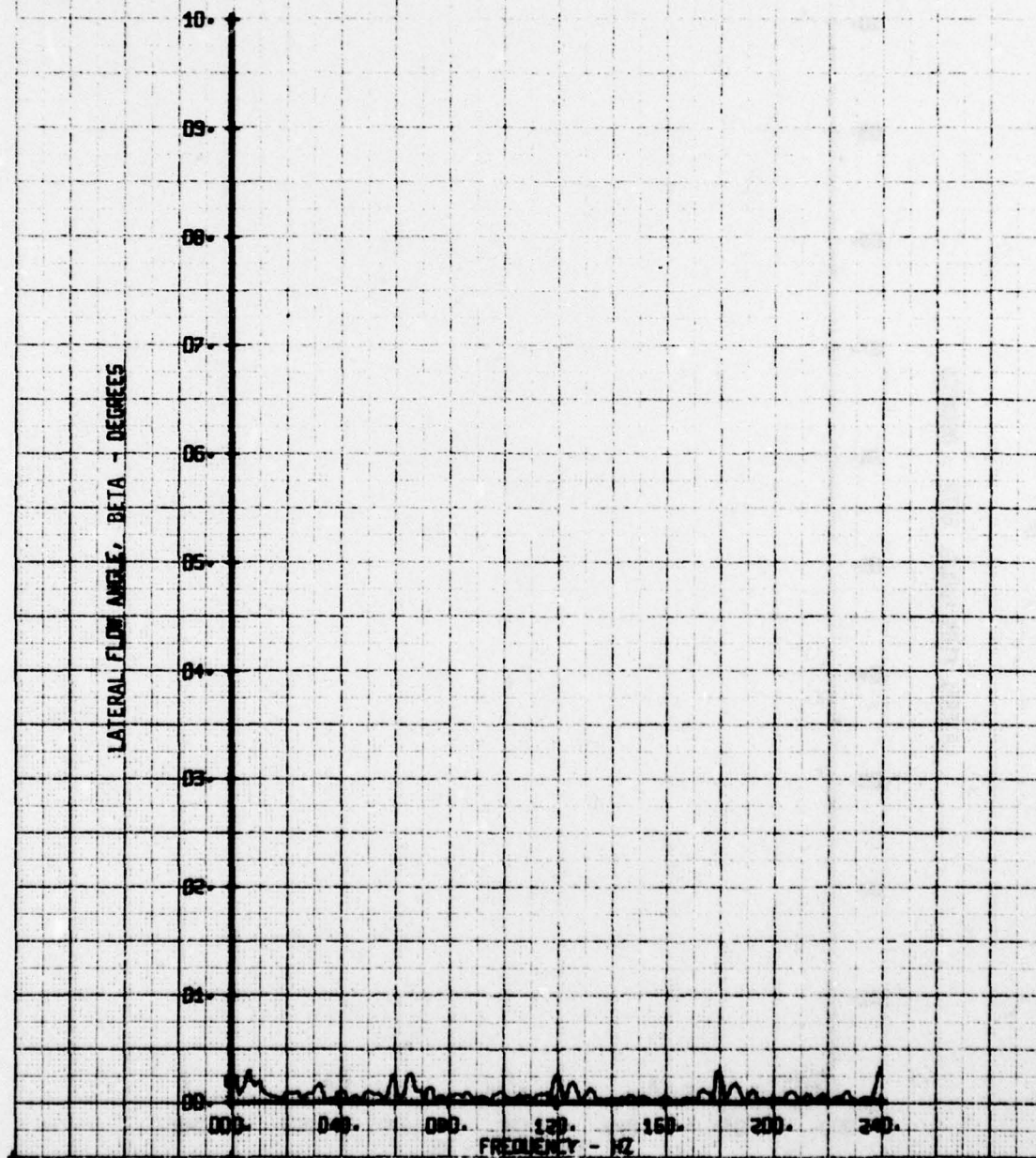
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



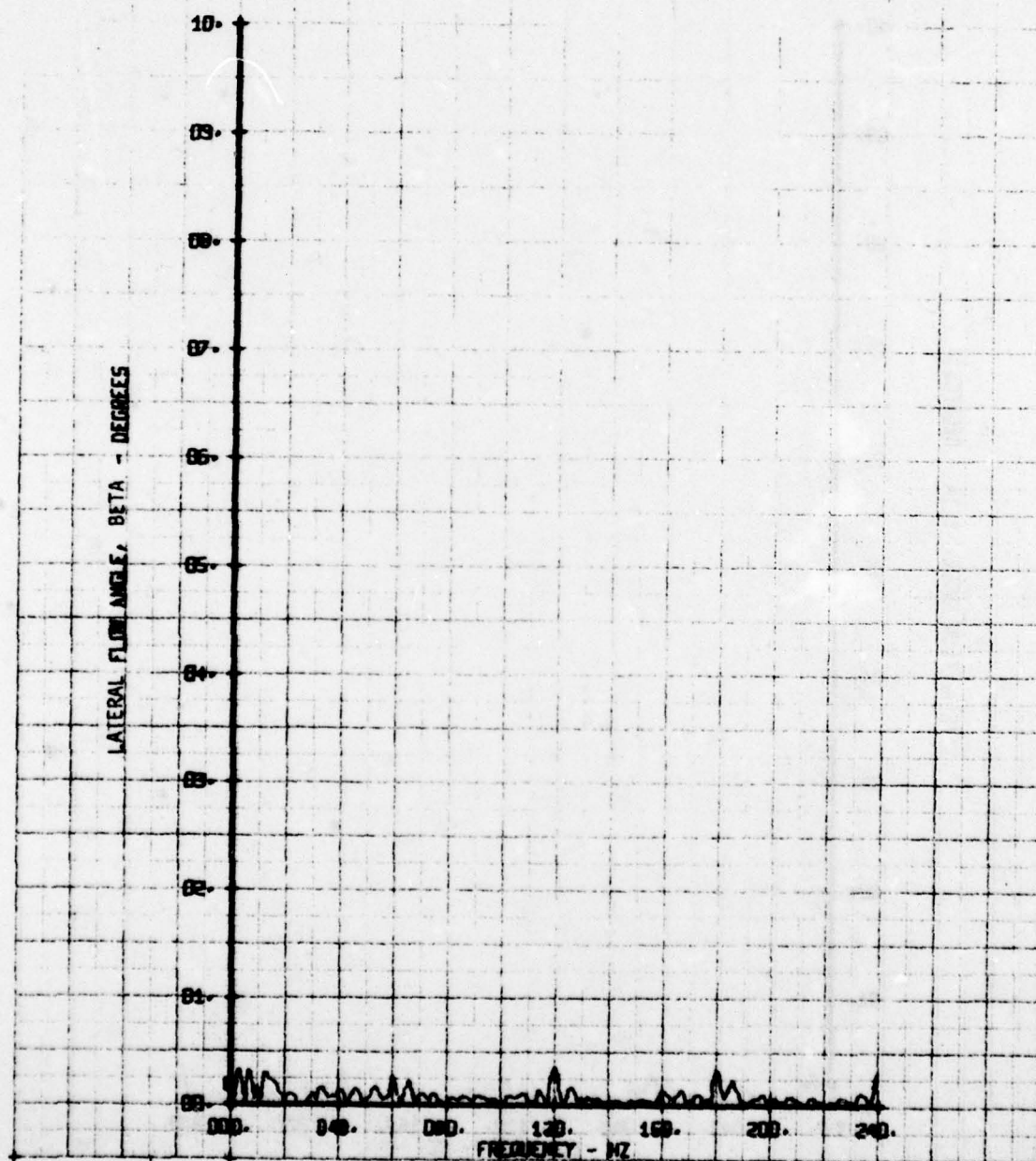
HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 158 TP 2

LEGEND
CH 65
PARAMETER
BETA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, HUB OFF
RUN 159 TP 3

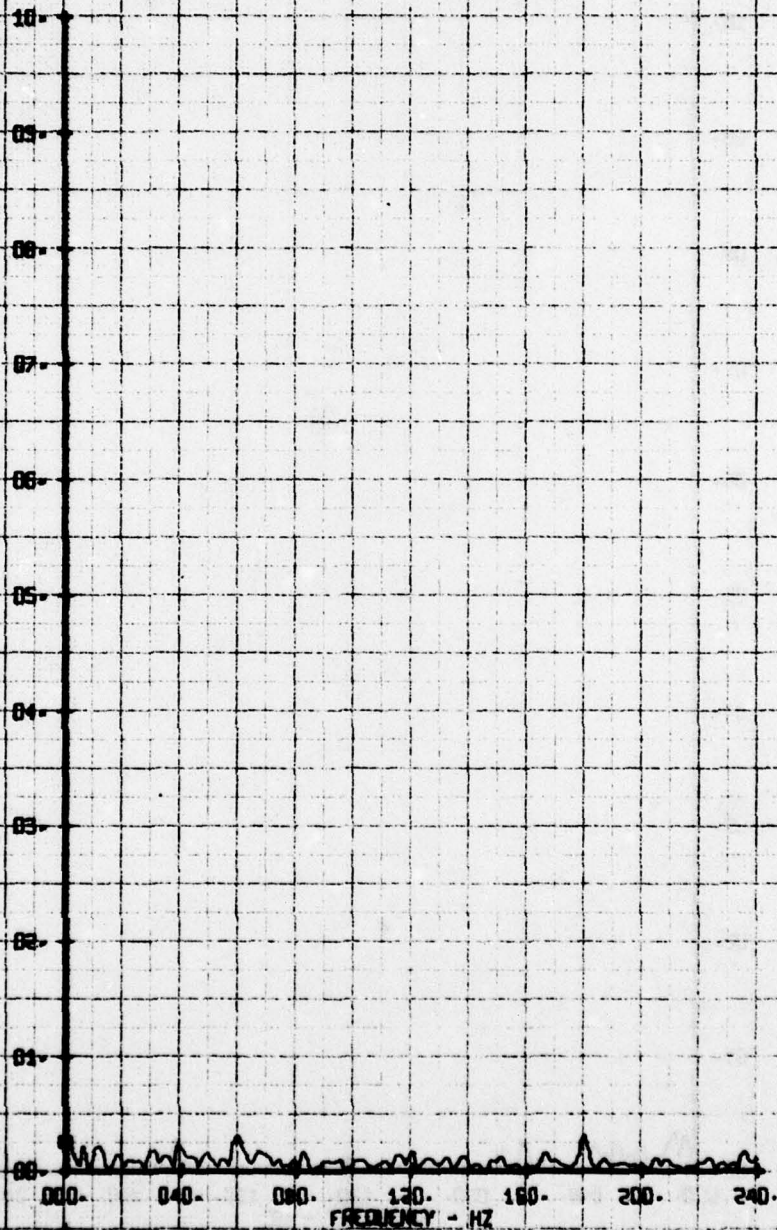
LEGEND
CH PARAMETER
65 BETA



HOT FILM WIRE FREQUENCY ANALYSTS
BASELINE BAL-BLADES OFF - HUB OFF
RUN 159 TP. 4

LEGEND
CN 65
PARAMETER
BETA

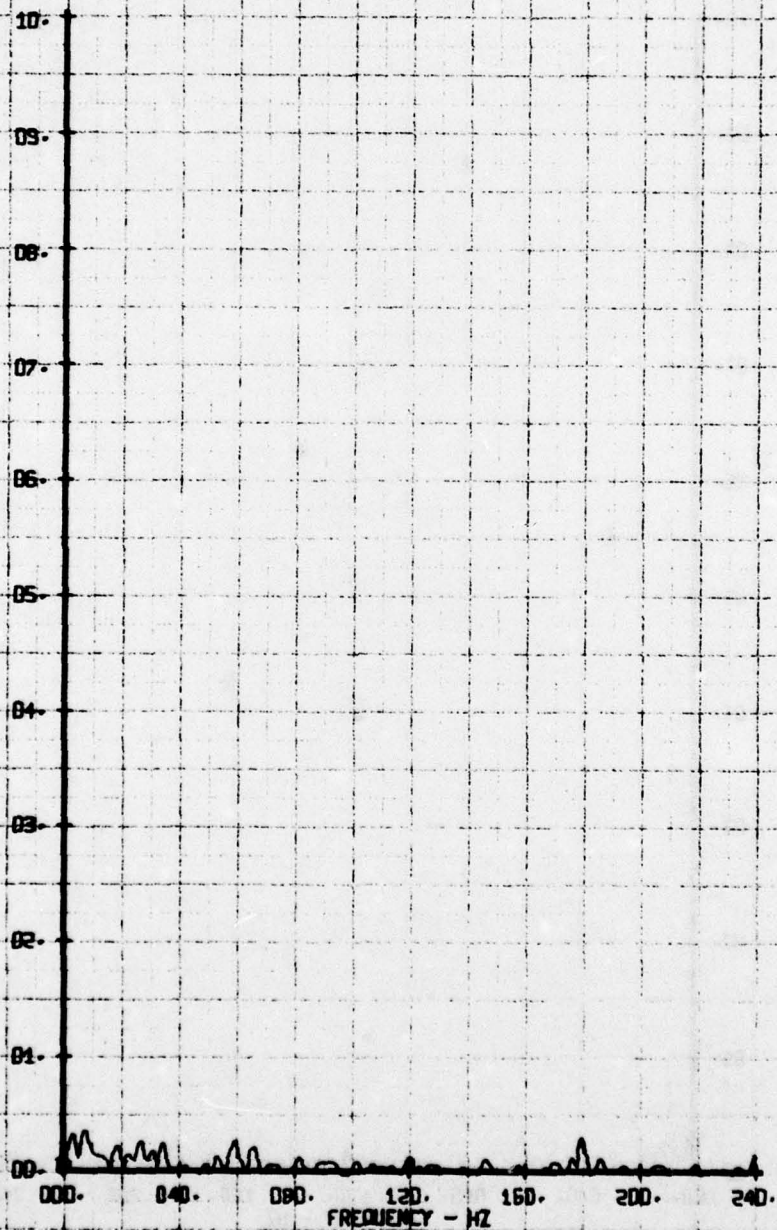
LATERAL FLOW ANGLE, BETA - DEGREES



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/L-BLADES OFF, HUB OFF
RUN 159 TP 5

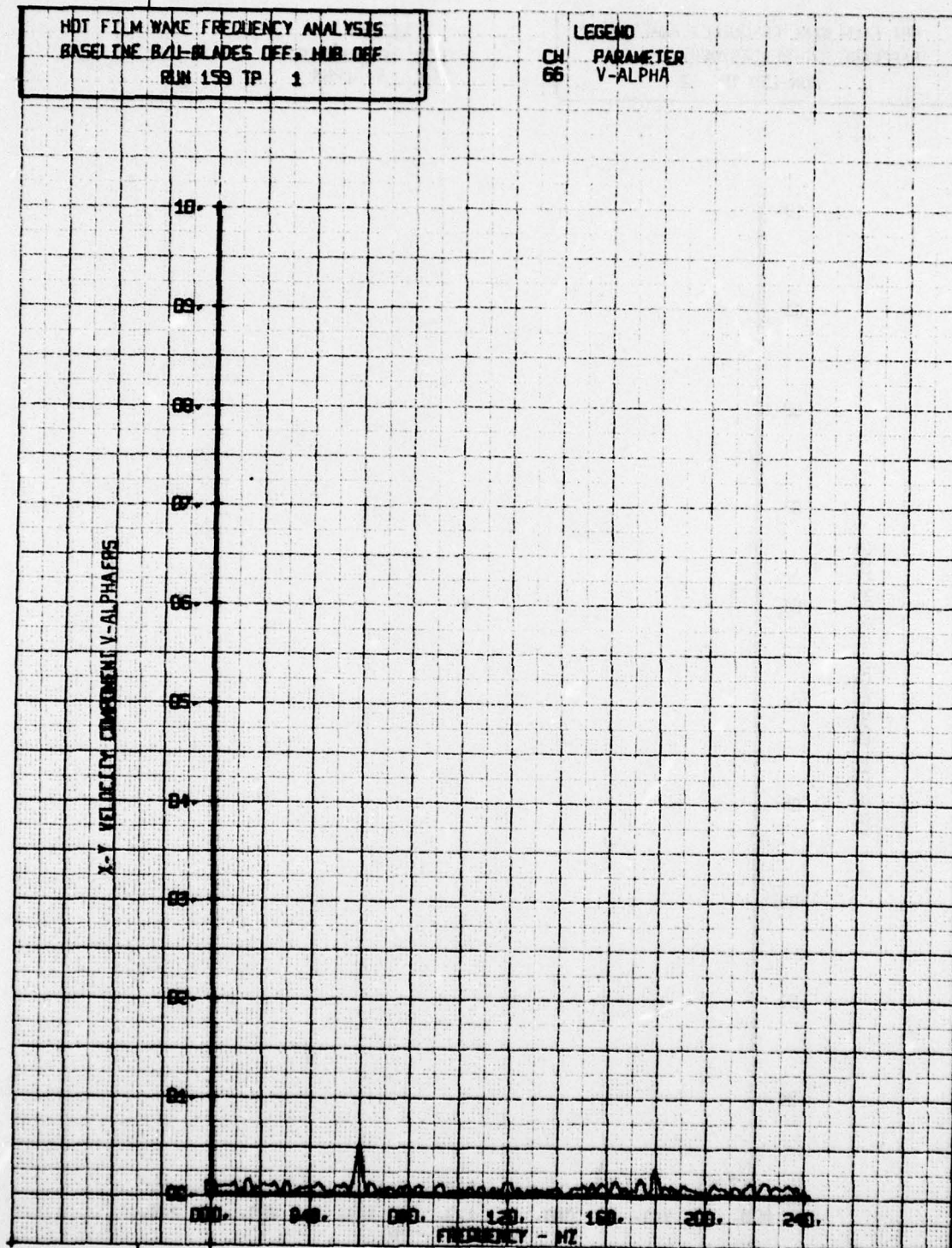
LEGEND
CH 65
PARAMETER
BETA

LATERAL FLOW ANGLE, BETA - DEGREES



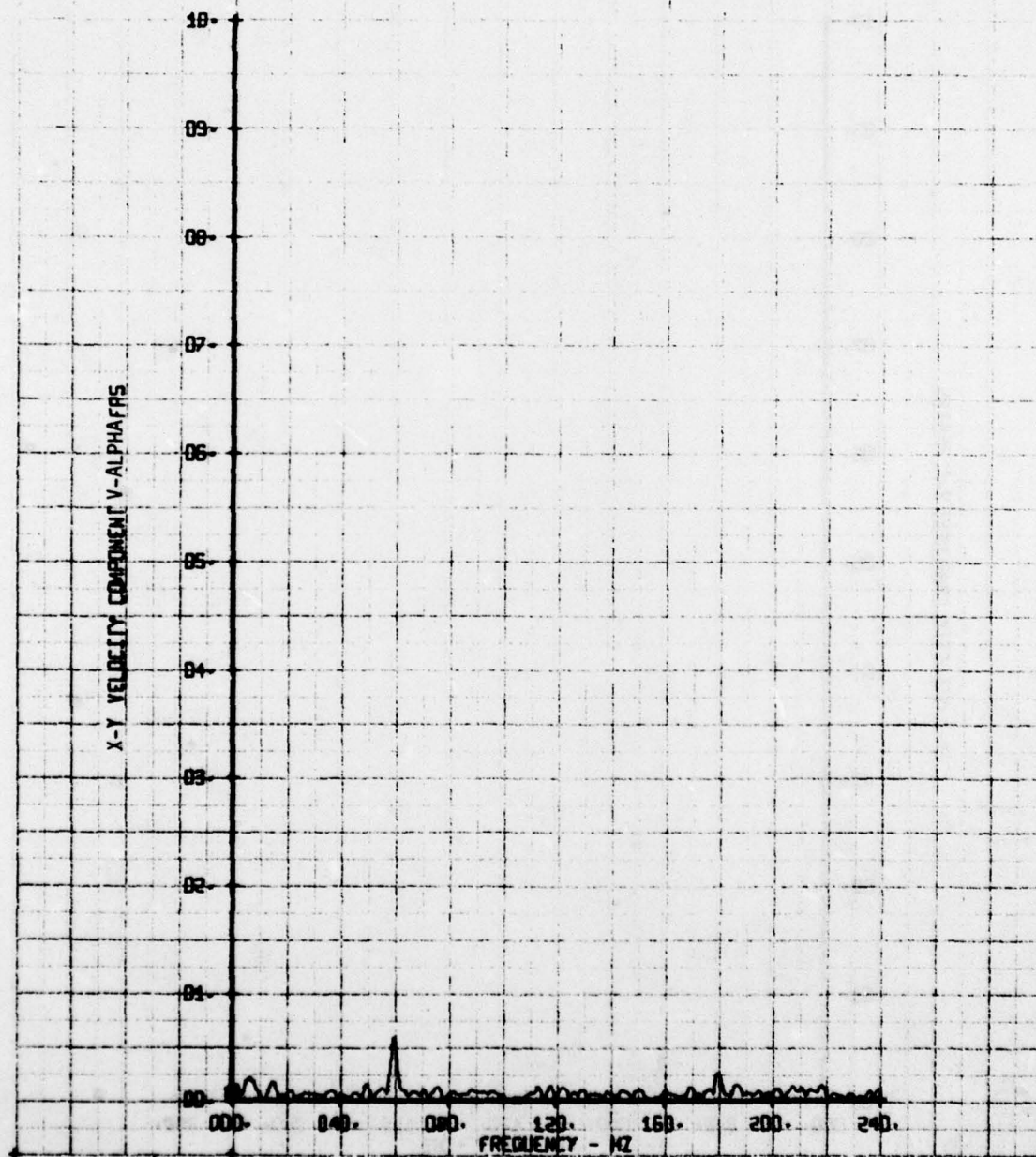
HDT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/L-BLADES OFF, HUB OFF
RUN 159 TP 1

LEGEND
CH 66
PARAMETER
V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 159 TP 2

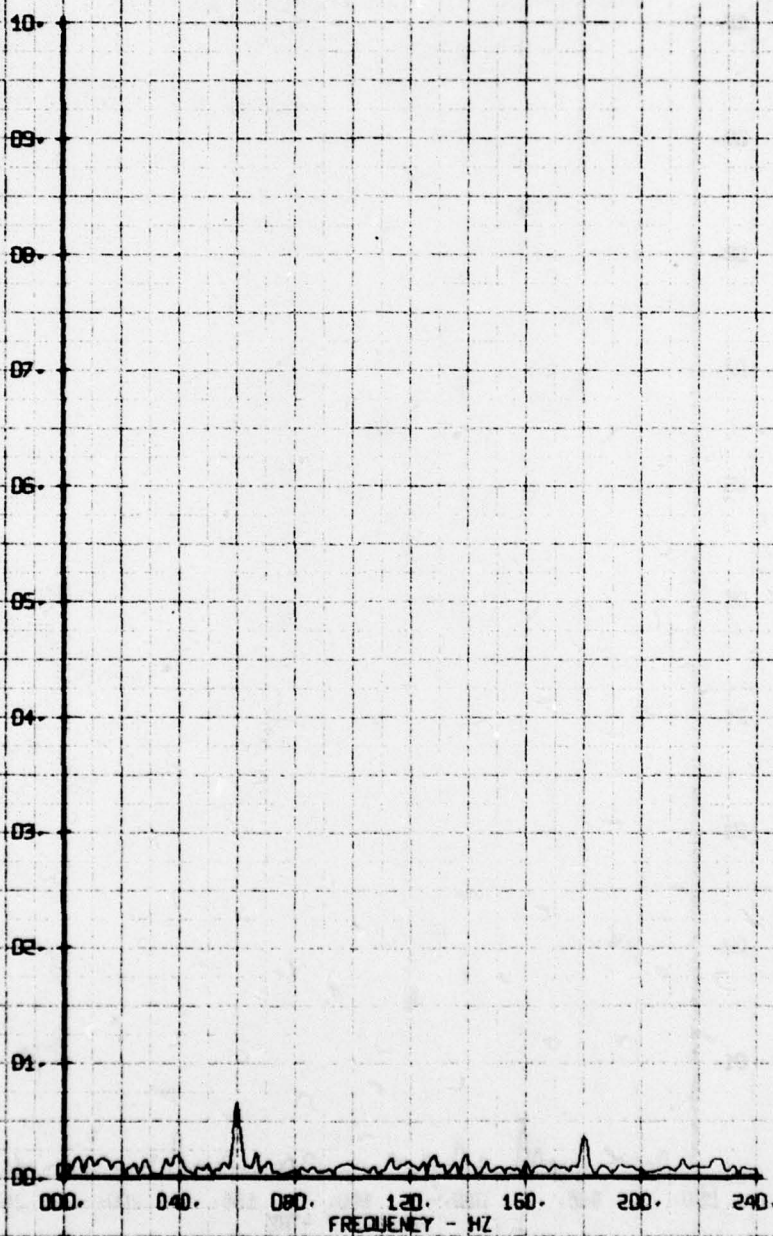
LEGEND
CH. 66 PARAMETER
V-ALPHA



HOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, HUB OFF
RUN 159 TP 3

LEGEND
CH 66
PARAMETER
V-ALPHA

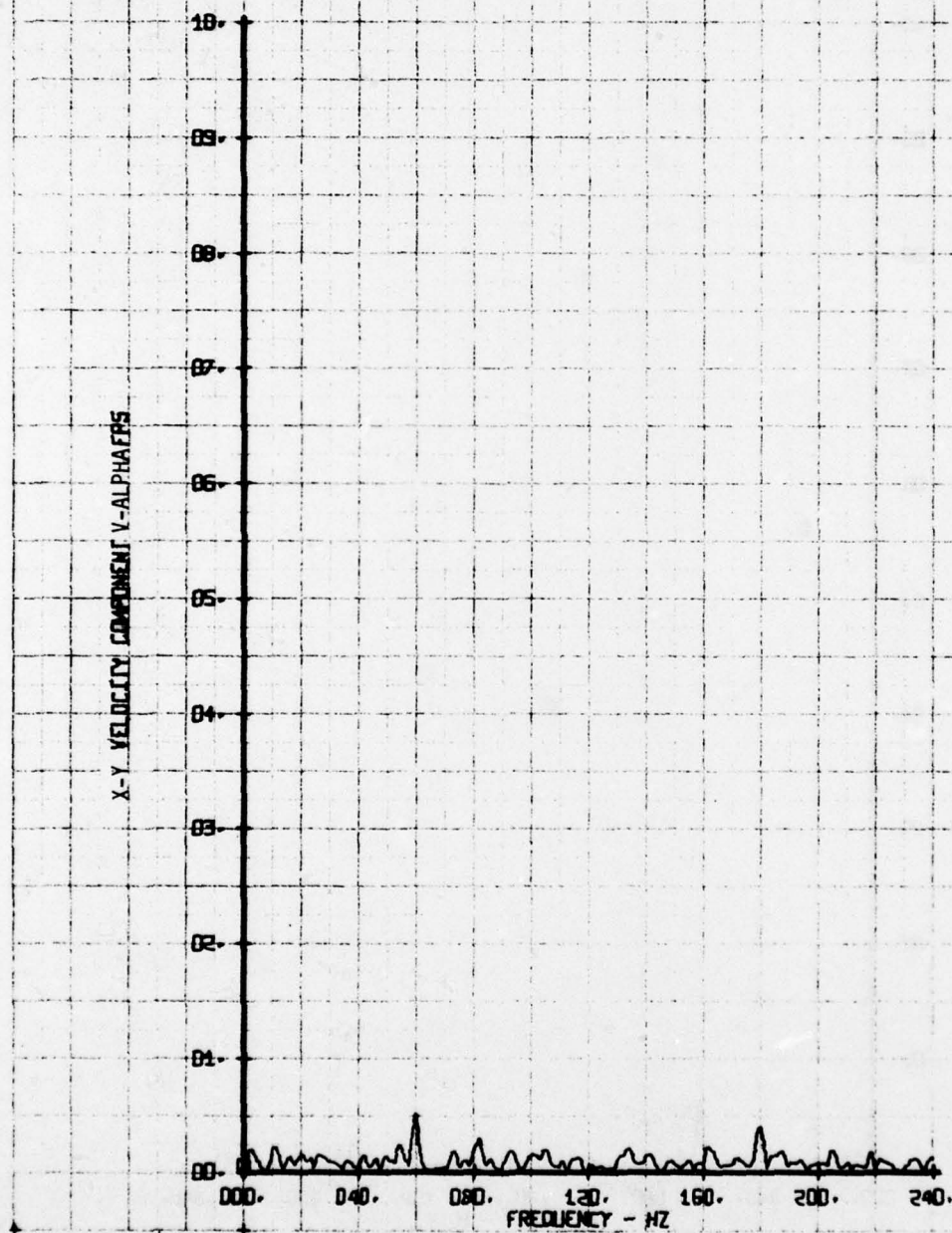
X-Y VELOCITY COMPONENT V-ALPHAS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 159 TP 4

LEGEND
CH. PARAMETER
66: V-ALPHA

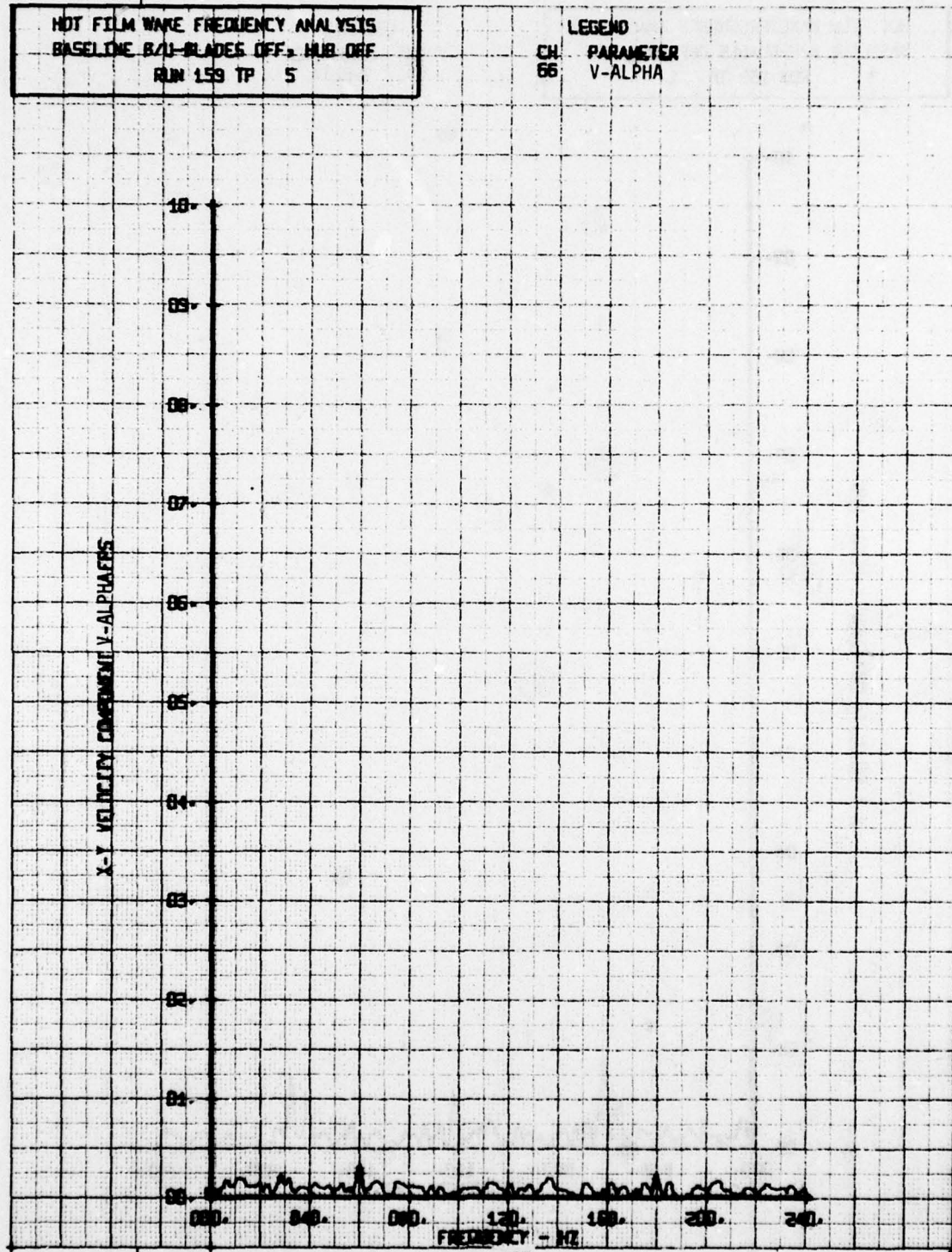
X-Y VELOCITY COMPONENT V-ALPHA EPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/11-BLADES OFF, HUB OFF
RUN 159 TP 5

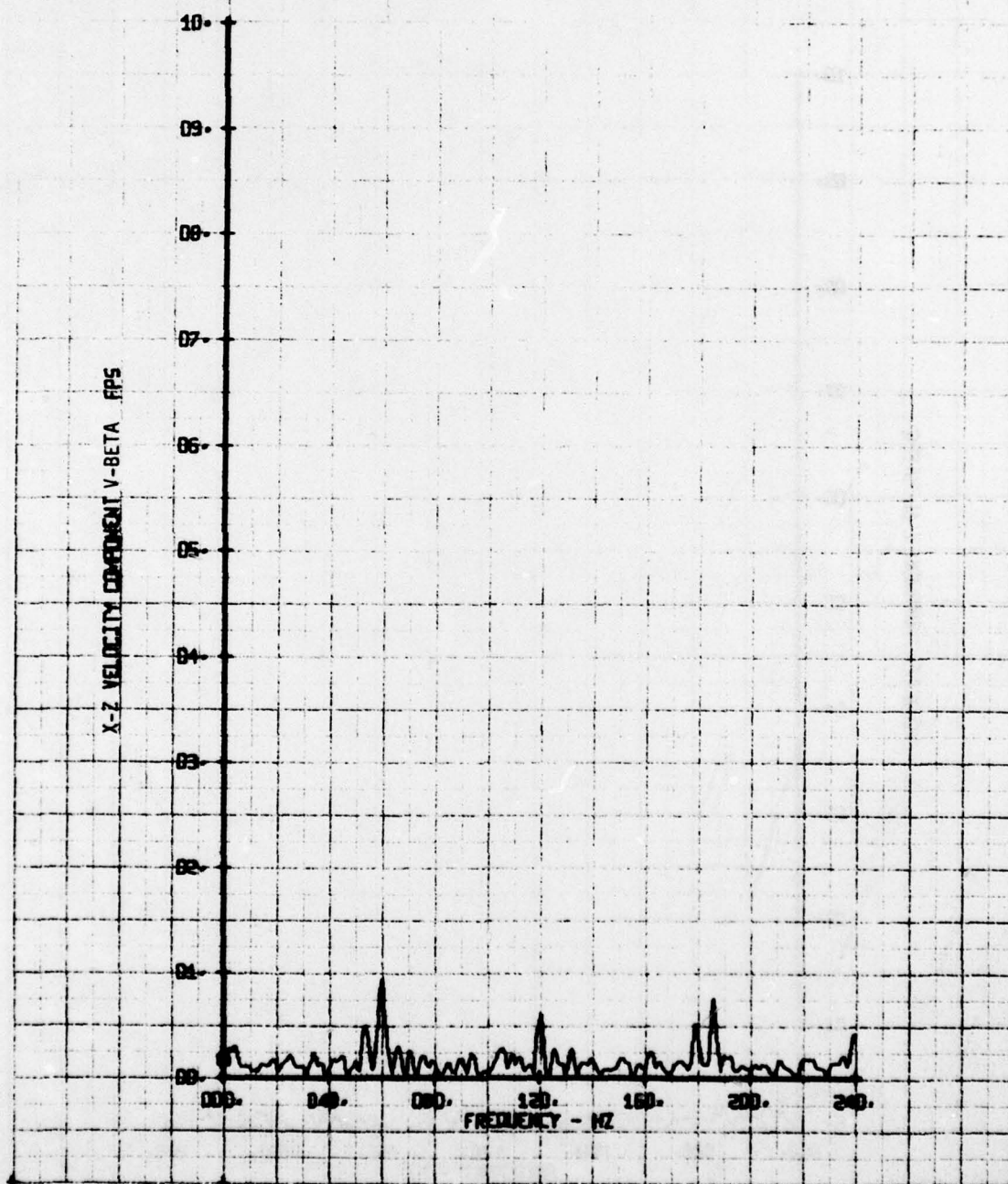
LEGEND
CH 66 PARAMETER
V-ALPHA

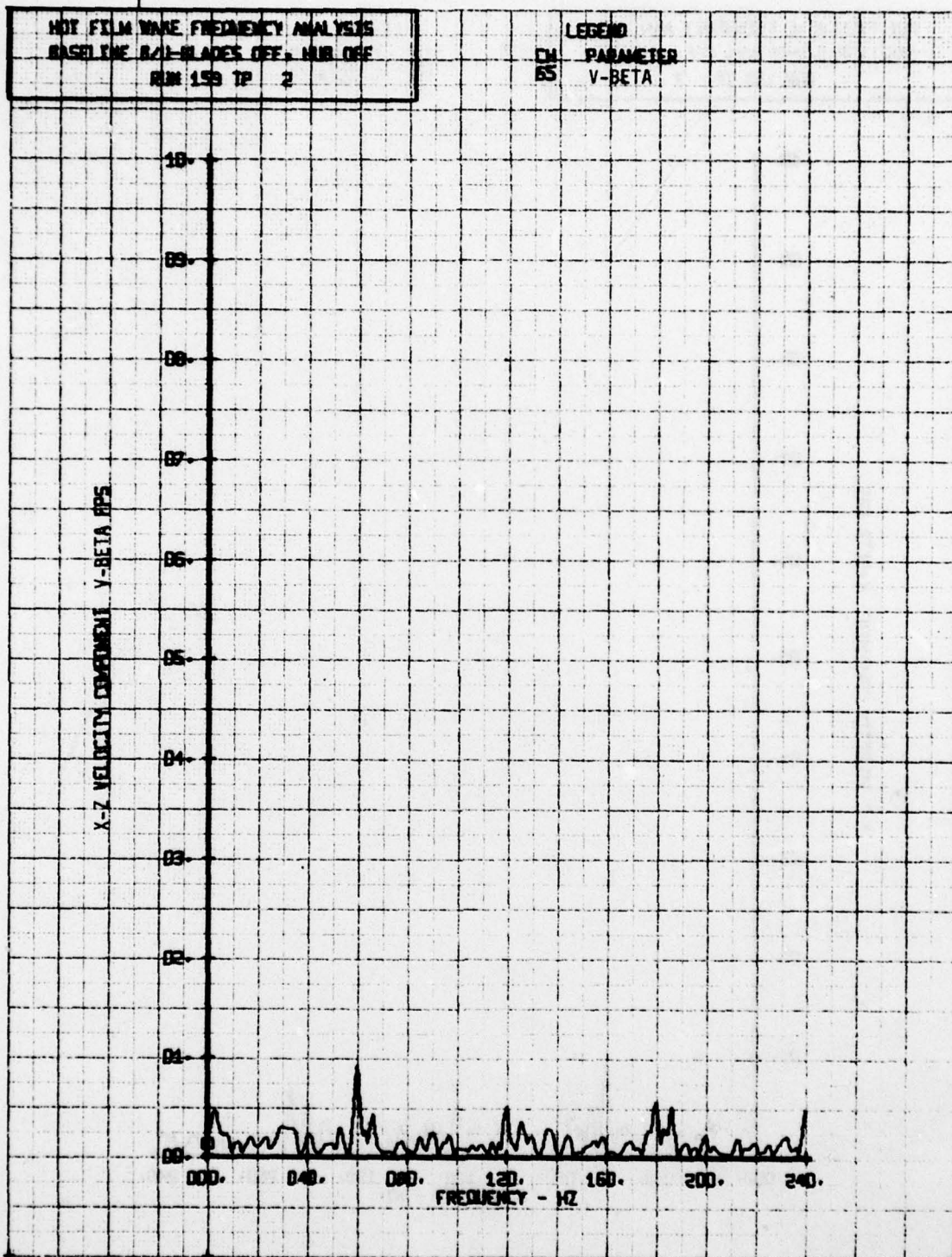
X-Y VELOCITY COMPONENT V-ALPHA



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, HUB OFF
RUN 159 TP 1

LEGEND
CH 65
PARAMETER
V-BETA

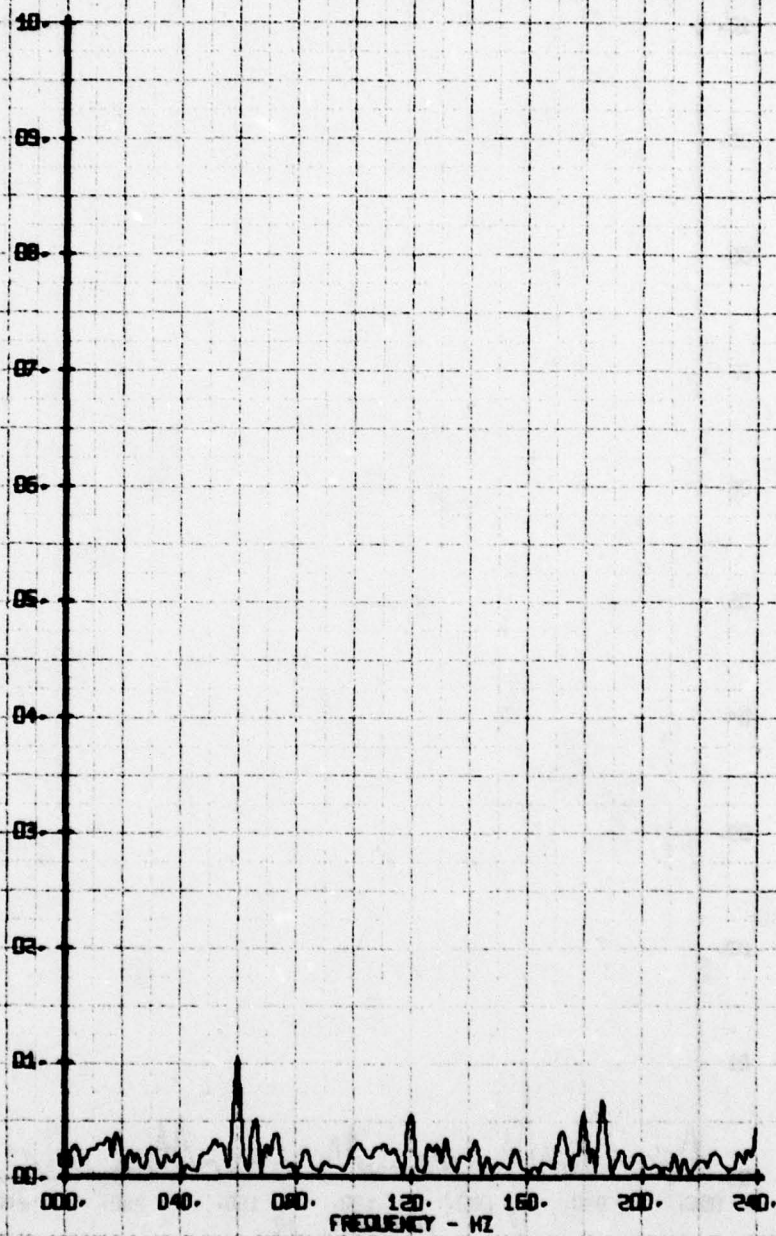




NOT FILM WAVE FREQUENCY ANALYSIS
BASELINE 8/1-BLADES OFF, HUB OFF
RUN 153 TP 3

LEGEND
CH 65
PARAMETER
V-BETA

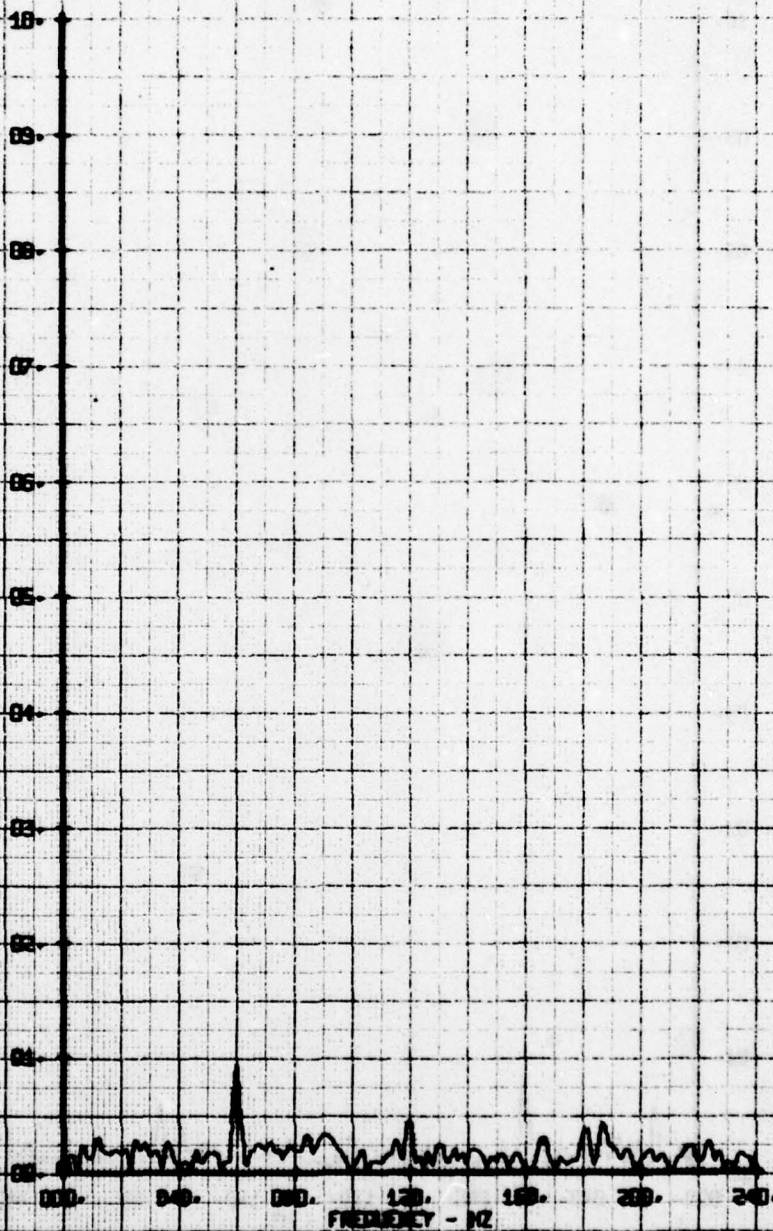
X-Z VELOCITY COMPONENT V-BETA EPS



NOT FILM WAKE FREQUENCY ANALYSIS
BASELINE R/1-BLADES OFF, HUB DEF
RUN 159 TP 4

LEGEND
CH PARAMETER
65 V-BETA

X-Z VELOCITY COMPONENT V-BETA FPS



HOT FILM WAKE FREQUENCY ANALYSIS
BASELINE B/U-BLADES OFF, HUB OFF
RUN 159 TP 5

LEGEND
CH 65 PARAMETER
V-BETA

X-Z VELOCITY COMPONENT V-BETA RMS

